

DTIC FILE COPY

CRC Report No. 568

(4)

CRC LOW- AND INTERMEDIATE- TEMPERATURE DRIVEABILITY PROGRAM USING GASOLINE- ALCOHOL BLENDS

AD-A221 321

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

February 1990

DTIC
ELECTRIC
MAY 09 1990
S E D

*Original contains color
plates: All DTIC reproductions
will be in black and
white.

90 05 08 268

COORDINATING RESEARCH COUNCIL, INC.
219 PERIMETER CENTER PARKWAY, ATLANTA, GEORGIA 30346

The Coordinating Research Council, Inc. (CRC) is a non-profit corporation supported by the petroleum and automotive equipment industries. CRC operates through committees made up of technical experts from industry and government who voluntarily participate. The four main areas of research within CRC are: air pollution (atmospheric and engineering studies); aviation fuels, lubricants, and equipment performance; heavy-duty vehicle fuels, lubricants, and equipment performance (e.g., diesel trucks); and light-duty vehicle fuels, lubricants, and equipment performance (e.g., passenger cars). CRC's function is to provide the mechanism for joint research conducted by the two industries that will help in determining the optimum combinations of petroleum products and automotive equipment. CRC's work is limited to research that is mutually beneficial to the two industries involved, and all information is available to the public.

COORDINATING RESEARCH COUNCIL

INCORPORATED

219 PERIMETER CENTER PARKWAY

ATLANTA, GEORGIA 30346

(404) 396-3400

**CRC LOW- AND INTERMEDIATE-TEMPERATURE DRIVEABILITY
PROGRAM USING GASOLINE-ALCOHOL BLENDS
(CRC Project No. CM-118-86/87)**

IN FORMULATING AND APPROVING REPORTS, THE APPROPRIATE COMMITTEE OF THE COORDINATING RESEARCH COUNCIL, INC. HAS NOT INVESTIGATED OR CONSIDERED PATENTS WHICH MAY APPLY TO THE SUBJECT MATTER. PROSPECTIVE USERS OF THE REPORT ARE RESPONSIBLE FOR PROTECTING THEMSELVES AGAINST LIABILITY FOR INFRINGEMENT OF PATENTS.

Prepared by the

Analysis Panel for the

1986/1987 CRC Intermediate- and Low-temperature Driveability Program

of the

CRC Volatility Group

February 1990

*Original contains color
plates: All LTO reproductions
will be in black and
white.

Automotive Vehicle Fuel, Lubricant, and Equipment Research Committee

of the

Coordinating Research Council, Inc.

• J452

Accession For

NTIS GRA&I ☒

DTIC TAB ☐

Unannounced ☐

Justification

By

Dist. ☐ /

Avail. ☐ Sales

Dist. ☐ /

A-1

TABLE OF CONTENTS

TEXT

	<u>Page</u>
ABSTRACT.....	i
I. INTRODUCTION.....	1
II. SUMMARY AND CONCLUSIONS.....	1
III. TEST DESIGN.....	2
IV. TEST TECHNIQUE.....	3
V. TEST FACILITIES.....	3
VI. TEST VEHICLES.....	4
VII. TEST FUELS.....	5
VIII. DATA PRESENTATION.....	5
A. Ambient Temperatures.....	5
B. Overall Total Weighted Demerits.....	5
C. Total Weighted Demerits by Malfunction.....	6
D. Fuel Tank Temperatures.....	6
IX. DATA ANALYSIS.....	6
A. Analysis of Variance.....	6
B. Performance Models.....	7
C. Check of Model Prediction with 1984 Program Results.....	11
<u>REFERENCES</u>	17

TABLES

Table I	Description of Test Vehicles - Intermediate-Temperature Phase.....	20
Table II	Description of Test Vehicles - Low-Temperature Phase.....	21
Table III	Summary of Test Fuel Properties.....	22
Table IV	Distribution of Run and Soak Temperatures.....	23
Table V	Cold-Start and Warmup Driveability Demerits (Intermediate-Temperature Phase).....	24
Table VI	Cold-Start and Warmup Driveability Demerits (Low-Temperature Phase).....	26
Table VII	Analysis of Variance.....	28
Table VIII	Comparison of Total Weighted Demerits (TWD's) Observed in 1984 CRC Intermediate-Temperature Program with those Predicted from the 1986/1987 CRC Program Intermediate-Temperature TWD Equation -Equation 2.....	29

TABLE OF CONTENTS - (Continued)

FIGURES

Figure 1	Test Site: Intermediate-Temperature Phase....	30
Figure 2	Test Site: Low-Temperature Phase.....	31
Figure 3	Intermediate Temperature Predicted TWD, Square-Root TWD Regression - Equation 1.....	32
Figure 4	Low Temperature Predicted TWD, Square-Root TWD Regression - Equation 1.....	33
Figure 5	Intermediate Temperature, Regression versus TWD - Equation 2.....	34
Figure 6	Low Temperature, Regression versus TWD - Equation 2.....	35
Figure 7	Predicted TWD Values (Equation 2) versus Average Observed TWD Values - 1984 Program Carbureted Cars.....	36
Figure 8	Predicted TWD Values (Equation 2) versus Average Observed TWD Values - 1984 Program Fuel-Injected Cars.....	37

APPENDICES

APPENDIX A	- Program Participants and Analysis Panel Membership.....	A-1
APPENDIX B	- 1986/1987 CRC Low- and Intermediate-Temperature Driveability Program Using Gasoline-Alcohol Blends.....	B-1
APPENDIX C	- Test Schedule.....	C-1
APPENDIX D	- Individual Laboratory Fuel Property Data.....	D-1
APPENDIX E	- Raw Data.....	E-1
APPENDIX F	- Warmed-Up Driveability Procedure Average Demerits.....	F-1
APPENDIX G	- Classification of Total Weighted Demerits by Malfunction.....	G-1
APPENDIX H	- Fuel Tank Temperatures.....	H-1
APPENDIX I	- SAS Program, Code, and Output.....	I-1

I. INTRODUCTION

Several previous CRC programs were conducted to determine the relationship of fuel volatility parameters to cold-start and warmup driveability performance. (1-5) With the increased use of gasoline-alcohol blends, the 1984 CRC program was conducted to determine the cold-start and warmup driveability performance of hydrocarbon-only and gasoline-alcohol blends. The purpose of the 1984 program was to provide performance data over a broad spectrum of fuel parameters at ambient temperatures of 40-60°F. The 1984 program was not specifically designed to develop a predictive equation.

The 1986/1987 CRC program was designed with the objective of characterizing the relationship between driveability performance and the volatility parameters of T_{10} , T_{50} , and T_{90} distillation temperatures of hydrocarbon-only and gasoline-alcohol blends in the nominal temperature ranges of 40-60°F and 0-20°F. Actual test temperatures ranged from 40°F to 60°F for the intermediate-temperature phase, and from 10°F to 40°F for the low-temperature phase. In addition, the data from these two phases provide the basis for predictive equations applicable for each program phase. Finally, the intermediate-temperature predictive equation was evaluated using independent data from the 1984 CRC Intermediate-Temperature Driveability Program.

Participants in the test program and members of the Data Analysis Panel are shown in Appendix A. The proposed program as approved by the CRC Volatility Group is shown as Appendix B.

II. SUMMARY AND CONCLUSIONS

The major conclusions of the program apply to both temperature phases:

- Low volatility fuels resulted in poorer driveability than higher volatility fuels.
- Low ambient temperatures resulted in poorer driveability than did intermediate ambient temperatures.
- Models were developed which adequately predict the performance of hydrocarbon-only fuels, 10 percent by volume gasoline-ethanol blends, and 9.5 percent by volume gasoline-methanol:TBA (1:1) blends, based upon the T_{10} , T_{50} , and T_{90} distillation temperatures.

- Carbureted vehicles exhibited poorer driveability than fuel-injected vehicles.
- Hydrocarbon-only gasolines gave significantly better driveability than gasoline-methanol:TBA blends and gasoline-ethanol blends.
- Regression equations which relate volatility to vehicle cold-start and warmup driveability were developed for both temperature phases.

III. TEST DESIGN

The test program was divided into two phases: the intermediate-temperature (40-60°F) phase conducted in Paso Robles, California, from October 13 through November 14, 1986; and the low-temperature (0-20°F) phase conducted in Brainerd, Minnesota, from January 19 through February 18, 1987.

The fuel parameters studied in this program include volatility (as defined by T_{10} , T_{50} , and T_{90}) and fuel type (hydrocarbon-only, gasoline-ethanol blends, and gasoline-methanol:TBA blends). Determining the effect of the volatility parameters required testing of fuels with independent variation in T_{10} , T_{50} , and T_{90} distillation temperatures. A one-half replicate of a three variable factorial design in two levels was used to determine the volatility effect of each fuel type. This required five fuels (four cornerpoint and one center-point) per fuel type for a total of fifteen fuels. Target temperatures for the T_{10} , T_{50} , and T_{90} distillation temperatures for these fuels are shown in the approved program (Appendix B).

Appendix C shows the test schedule for each run day including the vehicle/fuel/rater assignments. These assignments were based on a balanced design in which each rater evaluated one-third of the vehicle/fuel combinations. Tests were conducted on Days 16 through 22 in the intermediate-temperature phase and on Days 17 through 20 in the low-temperature phase to complete blocks of data unavailable due to weather and vehicle malfunctions.

IV. TEST TECHNIQUE

The CRC Cold-Start and Warmup Driveability Procedure was used for both phases of the program. The driving procedure was preceded by draining the vehicle fuel tanks, adding test fuel, and performing a ten-mile warmup. Performance of each vehicle was then evaluated for driveability on a fully warmed-up basis using the last two cycles of the cold-start and warmup procedure. The warmed-up driveability was used to help evaluate vehicle problems. Driveability malfunctions for the different driving maneuvers were recorded. Vehicles were then parked and allowed to soak overnight at ambient temperatures. During the low-temperature phase, the vehicles were started the next day using an external battery in parallel with the vehicle battery in order to eliminate the variable of battery condition; however, no starting aid was used during the intermediate-temperature phase. The vehicles were then driven using the first six cycles of the Cold-Start and Warmup Driveability Procedure. Driveability malfunctions were recorded for the series of engine idles, accelerations and decelerations, and constant speed cruises. A detailed description of the test procedure and rating system are given in Appendix B.

V. TEST FACILITIES

The intermediate-temperature phase of the program was conducted at the Paso Robles Municipal Airport in Paso Robles, California. The facility was paved, offered access to a local highway for vehicle preconditioning, and allowed overnight parking for the test vehicles adjacent to the test course. The test course was laid out on an auxiliary taxiway, as shown in Figure 1.

The low-temperature phase of the program was conducted at Brainerd International Raceway in Brainerd, Minnesota. A schematic of the test site is shown in Figure 2. The facilities included a drive-through fuel storage and vehicle refueling shed, equipment storage room, office space, overnight parking for the test cars adjacent to the track, and the track. Driveability tests were conducted on the straightaway of the track, with vehicle preconditioning for the next day's testing accomplished by driving four laps around the three-mile track. Snow removal equipment was available and used when required.

A twelve-volt fuel pump was used in Brainerd to drain the vehicle fuel tanks. It was possible to connect the pump to three vehicles simultaneously. Fuel tanks were drained by gravity feed in Paso Robles.

VI. TEST VEHICLES

The vehicle fleets for the two phases are described in Tables I and II. Twenty-six vehicles were tested in the intermediate-temperature phase; twenty-seven vehicles were tested in the low-temperature phase. The fleets for each phase were chosen to represent a variety of fuel systems.

For the intermediate-temperature phase, all vehicles were passenger cars, with the exception of two minivans, and all vehicles were equipped with automatic transmissions and air conditioning. There was one turbocharged car included in the test fleet. The majority of the vehicles were 1986 models; however, the test fleet included one 1984 model, four 1985 models, and two 1987 models. Of the twenty-six vehicles tested, eleven were General Motors products, four were from Ford Motor Company, five were from Chrysler Corporation, two were Toyotas, and one each was from AMC, Volkswagen, Nissan, and Honda. The fleet included nine carbureted vehicles, nine throttle-body-injected (TBI) vehicles and eight port-fuel-injected vehicles. Throughout the report, the fleet used in the intermediate-temperature phase is identified as Vehicles 1 through 26.

For the low-temperature phase, all vehicles were passenger cars, with the exception of one minivan and one four-wheel-drive vehicle driven in the two-wheel-drive mode. All vehicles were 1986 models and were equipped with automatic transmissions and air conditioning. There was one turbocharged car included in the test fleet. Of the twenty-seven vehicles tested, eleven were General Motors products, six were from Ford Motor Company, five were from Chrysler Corporation, two were Toyotas, and one each was from AMC, Volkswagen, and Honda. The fleet included nine each carbureted, TBI, and PFI vehicles. Throughout the report, the fleet used in the low-temperature phase is identified as Vehicles 41 through 68.

Fuel tank drains were installed on the vehicles by local dealerships. The emission and fuel systems were not checked. The fuel tank drain hoses, manifold vacuum taps, and vacuum lines were installed on each vehicle on-site by the participants. At the completion of each phase, the vehicles were returned to the dealer for removal of the tank drains.

It should be noted that the engine oil was changed after the second day of testing during the low-temperature phase. This was done to provide all the vehicles with fresh commercial 5W-30 engine oil and thus eliminate the possibility of starting problems due to varying engine oil.

VII. TEST FUELS

Test fuels consisted of three fuel types: hydrocarbon-only, hydrocarbon plus 10 percent by volume ethanol, and hydrocarbon plus 9.5 percent by volume methanol:TBA (1:1). Each fuel type consisted of five fuels which provided for independent variation of three volatility parameters: T_{10} , T_{50} , and T_{90} distillation temperatures. A summary of the fuel volatility properties used in both the intermediate- and low-temperature phases of this program are reported in Table III. The data shown in Table III are the average of results obtained from two laboratories, which are shown in Appendix D.

VIII. DATA PRESENTATION

A complete set of the vehicle test data for both the intermediate- and low-temperature phases may be found in Appendix E. This appendix summarizes the data collected from the individual data sheets. The analysis of data performed in the following sections used this data base with the following modifications. In the intermediate-temperature phase, Vehicle 23 on Days 1 through 4 evaluated Fuels 7 through 10, respectively. These runs were replaced on Days 19 through 22 with Fuels 7 through 10 due to vehicle malfunction. In the low-temperature phase, all evaluations on Day 6 were cancelled due to snow. Day 6 was replaced with Day 17. Because of high temperatures, Day 8 was repeated on Day 18. Four vehicles, Vehicle 51 on Fuel 3, Vehicle 53 on Fuel 8, Vehicle 54 on Fuel 8, and Vehicle 63 on Fuel 8, did not start and were unable to perform the driveability procedure.

A. Ambient Temperatures

The average soak and run temperatures for the intermediate- and low-temperature phases are shown below:

	<u>Soak, °F</u>	<u>Run, °F</u>
Intermediate-Temperature Phase	40.3	48.9
Low-Temperature Phase	18.1	22.7

The distributions of the run and soak temperatures for both phases are shown in Table IV.

B. Overall Total Weighted Demerits

The average demerits for the intermediate- and low-temperature phases using the CRC Cold-Start and Warmup Driveability Procedure are reported in Tables V and VI, respectively.

Similarly, the average demerits for the intermediate- and low-temperature phases with the vehicle fully warmed-up using only the last two cycles of the driveability procedure are reported in Appendix F. These warmed-up results show no noticeable differences in performance between fuel types and when compared on a carbureted, TBI, PFI, and fleet basis. Higher demerits are noted, however, when comparing the results of the low-temperature phase with those of the intermediate-temperature phase. Vehicle 57 exhibited vapor locking tendencies during the warmed-up portion of the test; however, no unusual performance problems were noted during the cold-start portion of the test.

C. Total Weighted Demerits by Malfunction

The types of malfunctions are reported for comparative purposes for both phases in Appendix G on a demerit and percent basis. There were no gross changes in the percent distribution of malfunctions across fuel type for each phase. A comparison of percent distribution of malfunctions between the two phases shows an increase in hesitation and a decrease in surge for the intermediate-temperature phase compared with the low-temperature phase.

D. Fuel Tank Temperatures

Fuel tank temperatures were recorded during each cold-start and warmup driveability evaluation and are reported in Appendix H.

IX. DATA ANALYSIS

The driveability data were analyzed using SAS⁽⁶⁻⁷⁾ procedures. SAS program, code, and output comprise Appendix I. The total weighted demerits (TWD) were first evaluated to determine if the errors were normally and independently distributed with constant variance. It was found that raw TWD's and residuals from performance models were not normally distributed. The square-root transform was found to be better than the log transform and was used in subsequent analyses.

A. Analysis of Variance

Analysis of variance (ANOVA) was used to determine the significance of the independent variables. A summary of this analysis is shown in Table VII. Fuel type, fuels within fuel type (e.g. overall volatility level), vehicle fuel system, vehicles within fuel system, rater, and run temperature were significant cold-start and warmup variables in both phases of the program. Therefore, these variables were investigated further when building the performance models. All determinations of significance were made at the 95 percent confidence level, and the items shown in Table VII exceed that.

B. Performance Models

Models which predict TWD's during the cold-start and warmup procedure have been developed for the two individual phases of the program. During the two phases, a total of 955 driveability tests were conducted. All of the test results were used for model development except for seven runs which gave extremely high residuals when the predicted values were compared to the measured values. All seven runs are considered outliers according to the outlier tests used by SAS. Three of the runs were made during the intermediate-temperature phase, and four were made during the low-temperature phase. The four outlier runs at low temperatures were due to the vehicles failing to start. On test day three, the port-injected Vehicle 51 would not start on hydrocarbon-only Fuel 3 at -5°F . On day two, when the temperature was 0°F , three vehicles failed to start on Fuel 8 which contained ethanol. Two of those vehicles, 53 and 54, were port-injected, and Vehicle 63 was carbureted. Although the temperatures during test days two and three were outside the scope of this program, they show that there do exist certain fuel/vehicle combinations and temperature conditions in which new vehicles will fail to operate. The current test procedure does not address those conditions, and further development on the procedure needs to be done. One suggestion was to assign the maximum possible number of demerits, but it was rejected because the result was that the four data points created extreme bias in the model. Lowering the maximum demerits to 530 also created bias, so those four runs were eliminated from the model.

The Least Squares Means, on pages I-9 and I-28 of the program output, show that at the 90 percent confidence level carbureted vehicles perform significantly poorer than fuel-injected vehicles; however, the differences between PFI and TBI vehicles were not significant. Hydrocarbon-only fuels performed significantly better than gasoline-ethanol blends, and the gasoline-ethanol blends performed better than the gasoline-methanol:TBA blends.

Based upon the data from this program, several models have been developed for predicting TWD's during the cold-start portion of the driveability procedure. The models reflect the average performance of the vehicles tested during this program, and may or may not predict the performance of other cars or other fuels at differing conditions. In addition, the validity of the model only exists over the distillation range of the fuels tested. The coefficients listed on page 8 can be used to calculate the square root of the TWD's for carbureted vehicles, TBI vehicles, and PFI vehicles using hydrocarbon-only fuel, gasoline-ethanol blends, or gasoline-methanol:TBA blends at the average temperatures for the two phases. The coefficients for the fuel variables T_{10} , T_{50} , and T_{90} remain unchanged for a given program phase, but the intercept changes depending on the fuel system and fuel type. All of the models use the same form of equation; only the coefficients are different.

1. Individual Program Phases - Square Root TWD Regressions

The driveability performance model shown below can be used to estimate TWD's for the three fuel systems and three fuel types tested. The absence of a run temperature term should be noted. The calculated TWD's represent performance at either 48°F or 23°F, which are the average values for the intermediate- and low-temperature phases. The coefficients of the T₁₀, T₅₀, and T₉₀ distillation temperatures remain unchanged for a given program phase, and their relative importance in predicting TWD's is fairly consistent across the two phases. The intercept term (B₀), however changes depending upon the fuel-system type and fuel type. The R-square values are 0.68 and 0.70 for the intermediate and low-temperature phases, respectively.

INDIVIDUAL-PHASE DRIVEABILITY PERFORMANCE MODEL - SQUARE ROOT TWD

$$\text{TWD} = (B_0 + B_1 \cdot T_{10} + B_2 \cdot T_{50} + B_3 \cdot T_{90})^2 \quad \text{Equation 1}$$

Intermediate-Temperature Phase
(Average 48°F)

Low-Temperature Phase
(Average 23°F)

B₁ = 0.0430
B₂ = 0.0456
B₃ = 0.0137

B₁ = 0.0378
B₂ = 0.0418
B₃ = 0.0140

Hydrocarbon-only Fuels

Carbureted
TBI
PFI

B₀ = -12.8318
B₀ = -14.9367
B₀ = -16.2069

B₀ = -7.6676
B₀ = -9.6884
B₀ = -10.6780

Fuels with 10% Ethanol

Carbureted
TBI
PFI

B₀ = -11.7945
B₀ = -13.6008
B₀ = -15.3131

B₀ = -6.3634
B₀ = -9.5999
B₀ = -9.9471

Fuels with 9.5% Methanol:TBA at 1:1 Ratio

Carbureted
TBI
PFI

B₀ = -10.6340
B₀ = -12.9021
B₀ = -14.6193

B₀ = -6.2862
B₀ = -8.0933
B₀ = -9.6272

The fuel-volatility-parameters coefficients, B_1 , B_2 , and B_3 , are very similar for the two program phases, indicating similar responses in driveability performance to fuel-volatility changes at the two test temperatures. In general, the T_{50} coefficient is only slightly larger than the T_{10} coefficient, and both these terms are considerably larger than the T_{90} coefficient.

The intercept term; B_0 , is greatest for the carbureted vehicles in each fuel-composition category at both temperatures, followed by TBI and PFI. The lower B_0 intercepts indicate better predicted driveability. The driveability ranking of fuel-delivery from best to poorest is thus PFI, TBI, carbureted, when judged on fuels of equal volatility and composition.

The effects of fuel composition can be judged by comparing the B_0 intercept for each fuel composition for each fuel-metering system. In every case, the hydrocarbon-only B_0 term is less than the gasoline-ethanol fuel term which is less than the gasoline-methanol:TBA fuel term. This indicates that in any given fuel-delivery system, fuel compositions perform in the order of hydrocarbon-only, hydrocarbon plus 10 percent by volume ethanol, and hydrocarbon plus 9.5 percent by volume methanol:TBA (1:1) from best to poorest with fuels of equal T_{10} , T_{50} , and T_{90} .

Figures 3 and 4 show the predicted TWD's for each of the fifteen fuels for each of the three fuel-metering systems for the intermediate- and low-temperature program phases, respectively, as a function of the square of the average square root of TWD. A 1:1 reference line is also shown on each of the plots for ease of comparison. The scatter of data about the 1:1 line is not strictly a function of the equation fit to the data, but is also a function of the balance of the programs, as conducted, about the average values for the program. For example, in the low-temperature phase, one PFI data point with Fuel 6 (gasoline-ethanol blend) seems particularly out-of-line. The predicted value is 56 for an observed average-square-root-TWD-squared value of 91. Data in Appendix E indicate that eight of the nine runs which comprise this data point were at ambient temperatures less than 23°F , the average of the low-temperature phase. This tends to justify lower predicted demerits for the average vehicle with the average driver at the average ambient temperature.

Overall, there does not appear to be any serious bias due to fuel type and/or fuel-delivery system.

2. Individual Program Phases - TWD Regressions

Although analysis of the data from this program using the square-root form transform is superior because the residuals are more normally distributed than analysis based on raw TWD's, there is difficulty in grasping the relative importance of differences in coefficients.

The same analysis was thus performed using raw TWD values. R-square values were 0.65 and 0.67 for the intermediate- and low-temperature phases, respectively. The following table shows the volatility coefficients and intercept values for the equation; however, the data should be used with caution since residuals from analysis of the raw data cannot be shown to be normally distributed using the Kolomogorov D statistic.

INDIVIDUAL-PHASE DRIVEABILITY PERFORMANCE MODEL-TWD

$$\text{TWD} = A_0 + A_1 * T_{10} + A_2 * T_{50} + A_3 * T_{90} \quad \text{Equation 2}$$

Intermediate-Temperature Phase
(Average 48°F)

$$\begin{aligned} A_1 &= 0.7443 \\ A_2 &= 0.6776 \\ A_3 &= 0.2981 \end{aligned}$$

Low-Temperature Phase
(Average 23°F)

$$\begin{aligned} A_1 &= 0.8253 \\ A_2 &= 0.9418 \\ A_3 &= 0.3307 \end{aligned}$$

Hydrocarbon-only Fuels

Carbureted	$A_0 = -277.57$	$A_0 = -285.47$
TBI	$A_0 = -310.04$	$A_0 = -329.15$
PFI	$A_0 = -323.61$	$A_0 = -344.86$

Fuels with 10% Ethanol

Carbureted	$A_0 = -263.49$	$A_0 = -250.67$
TBI	$A_0 = -293.15$	$A_0 = -322.68$
PFI	$A_0 = -311.78$	$A_0 = -329.33$

Fuels with 9.5% Methanol:TBA at 1:1 Ratio

Carbureted	$A_0 = -240.49$	$A_0 = -247.43$
TBI	$A_0 = -286.68$	$A_0 = -293.42$
PFI	$A_0 = -300.88$	$A_0 = -323.00$

The fuel-volatility coefficients A_1 , A_2 , and A_3 indicate the same general relationship as in Equation 1. The T_{10} and T_{50} weightings are approximately equal, as was the case previously, and are considerably higher than the T_{90} weighting. This table indicates the T_{10} has slightly more importance than the T_{50} at intermediate temperatures, and slightly less importance at the low temperatures.

The intercept terms, A_0 , indicate the same general findings as Equation 1; i.e., vehicles rank in the order PFI, TBI, and carbureted from best to poorest, respectively. The intercepts can be subtracted to obtain any delta desired; i.e., the difference between TBI and carbureted vehicles on hydrocarbon-only fuels is estimated to be 33 TWD's at intermediate temperatures, and 44 TWD's at low temperatures when performance is judged on fuels of the same volatility.

Also, fuels rank in the same order as previously; hydrocarbon-only, gasoline-ethanol blends, gasoline-methanol:TBA blends from best to poorest, respectively. In carbureted vehicles, gasoline-ethanol blends at the same volatility as hydrocarbon-only fuels would be expected to produce 14 TWD's more than the hydrocarbon-only fuel at intermediate temperatures and 35 TWD's more at low temperatures.

Figures 5 and 6 show the predicted TWD values using Equation 2 for the intermediate- and low-temperature program phases, respectively, as a function of the average TWD observed as shown in Tables V and VI. A 1:1 line is also shown for convenience. Overall, there does not appear to be any serious bias due to fuel type and/or fuel-delivery system. Also, the fits shown do not appear to be any better or worse than those shown previously using the square-root-TWD equation in Figures 3 and 4.

3. Combined Program Phases

An attempt was made to combine the results of the two phases into a single model containing a temperature coefficient. The models developed, however, were rejected because of the overlapping temperature ranges and the fleet differences. In addition, the models were not statistically justified because of the increased complexity and limited range. The models also did not fit the results of the 1984 program as well as the individual-phase models.

C. Check of Model Prediction with 1984 Program Results

In 1984, a driveability program was conducted at Paso Robles, California, to assess the driveability performance of hydrocarbon-only and gasoline-alcohol blends at intermediate temperatures. Six of the fuels used in that program were similar in composition and distillation temperatures to the fuels used in this program. It thus seemed appropriate to assess the fit of the intermediate-temperature equation to the results of the 1984 program on these six fuels.

The 1984 program consisted of three Subprograms, labeled A, B, and C. Each Subprogram used twelve vehicles (nine carbureted, two TBI, and one PFI) to evaluate several fuels. The results of Subprogram A, which evaluated two hydrocarbon-only fuels and two 10 percent by volume gasoline-ethanol blends, are shown in the upper portion of Table VIII. Results shown are the average TWD's for the carbureted vehicles and the fuel-injected vehicles separately and the predicted TWD from Equation 2. For the fuel-injected-vehicle prediction, a combined TBI:PFI value weighted 2:1 on the basis of square root TWD has been used, since this is the weighting between the two fuel-delivery systems in the 1984 subprograms.

The bottom half of Table VIII shows the 1984 data for Subprograms B and C combined. These two Subprograms both evaluated the hydrocarbon-only fuels and two 9.5 percent by volume gasoline-methanol:TBA blends.

Figure 7 shows the predicted TWD values for the carbureted vehicles as a function of the average TWD's generated in the 1984 program. Four lines are shown on the plot, one for each unique vehicle group-fuel composition. The Subprogram A data are all above the 1:1 reference line shown on the plot. This is of no consequence. It simply means that raters and/or vehicles in the 1986/1987 program were more severe than the 1984 Subprogram A vehicles and/or raters; and the 1986/1987 regression equation, therefore, predicts higher demerits than were observed in 1984 for fuels of these volatilities. The slopes of the HC and EtOH fuel compositions in the Subprogram A vehicles are very similar to each other and to the 1:1 line. This indicates that the 1984 TWD response to volatility changes was similar within each fuel composition, and also similar to the 1986/1987 response to volatility differences. The offset between the HC and EtOH lines for the Subprogram A data indicates that the gasoline-ethanol blends performed slightly poorer relative to the hydrocarbon-only fuels in 1984 than in the 1986/1987 data.

Figure 7 also shows two lines representing the combined data for the Subprogram B and C vehicles in the 1984 program. The BC-HC line is much closer to the 1:1 regression line, indicating that this group of vehicles was closer in demerit level to the 1986/1987 demerit level than the Subprogram A vehicles. The slope of the BC-HC line being slightly greater than the 1:1 line indicates slightly less change in demerit levels on the hydrocarbon-only fuels for a given change in volatility than was observed in the 1986/1987 program. Similarly, the lesser slope of the BC-MeOH:TBA line indicates greater response in TWD in the 1984 program to fuel volatility changes with this composition than was observed in the 1986/1987 program.

Figure 8 presents the data for the fuel-injected vehicles in the same manner. Again, all data are above the 1:1 reference line indicating fewer TWD's in 1984 than in the 1986/1987 program for similar volatilities and compositions. The Subprogram A data indicates that the EtOH fuel performed slightly better relative to the hydrocarbon-only fuels, compared with the 1986/1987 program. This is opposite to the observation indicated for the carbureted Subprogram A vehicles.

Overall, considering both Figures 7 and 8, it appears that driveability responses to both fuel volatility and fuel composition were similar in the 1984 and 1986/1987 programs. The only difference appears to be that the 1986/1987 program generated more TWD's at intermediate temperatures using similar fuels than did the 1984 program.

REFERENCES

REFERENCES

1. Coordinating Research Council, Inc., "1972 CRC Intermediate Temperature Driveability Program - Paso Robles," CRC Report No. 483, December 1975.
2. Coordinating Research Council, Inc., "Driveability Performance of 1975 Passenger Cars at Intermediate Ambient Temperatures - Paso Robles," CRC Report No. 486, May 1976.
3. Coordinating Research Council, Inc., "Driveability Performance of 1977 Passenger Cars at Intermediate Ambient Temperatures - Paso Robles," CRC Report No. 499, September 1978.
4. Coordinating Research Council, Inc., "Effects of Fuel Volatility on Driveability of 1980 Model Cars at Low and Intermediate Ambient Temperature, CRC Report No. 524, March 1982.
5. Coordinating Research Council, Inc., "1984 CRC Intermediate Temperature Driveability Program Using Gasoline-Alcohol Blends," CRC Report No. 554, August 1987.
6. SAS Institute, Inc. "SAS User's Guide: Basics, Version 5 Edition," 1985.
7. SAS Institute, Inc. "SAS User's Guide: Statistics, Version 5 Edition," 1985.

T A B L E S
AND
F I G U R E S

TABLE I

DESCRIPTION OF TEST VEHICLES - INTERMEDIATE-TEMPERATURE PHASE

<u>Make</u>	<u>Model⁽¹⁾</u>	<u>Eng. Displ. (liters)</u>	<u>Fuel System⁽⁵⁾</u>
Nissan	Sentra ⁽²⁾	1.6	Carb
Buick	Regal ⁽³⁾	3.8	Carb
Chevrolet	Caprice ⁽³⁾	5.0	Carb
Chevrolet	Sprint	1.0	Carb
Dodge	Aries ⁽³⁾	2.2	Carb
Chrysler	Fifth Avenue ⁽²⁾	5.2	Carb
Mercury	Lynx	1.9	Carb
Honda	Accord	2.0	Carb
Toyota	Corolla	1.6	Carb
Oldsmobile	Ciera	2.8	TBI
Pontiac	Sunbird	1.8	TBI
Chevrolet	Astro (Van)	4.3	TBI
Chevrolet	Cavalier	2.0	TBI
Mercury	Topaz	2.3	TBI
Chrysler	LeBaron	2.5	TBI
Dodge	600 ⁽⁴⁾	2.2	TBI
Renault	Alliance	1.7	TBI
Oldsmobile	Ciera	2.5	TBI
Oldsmobile	Delta 88	3.8	PFI
Oldsmobile	Calais	3.0	PFI
Pontiac	6000	2.8	PFI
Ford	Aerostar (Van)	3.0	PFI
Mercury	Cougar	5.0	PFI
Chrysler	LeBaron (Turbo)	2.2	PFI
Volkswagen	Golf	1.8	PFI
Toyota	Camry ⁽³⁾	2.0	PFI

(1) 1986 model year vehicles unless otherwise noted.

(2) 1987 model year vehicles.

(3) 1985 model year vehicles.

(4) 1984 model year vehicles.

(5) Carb = carbureted; PFI = port-fueled-injected;
TBI = throttle-body-injected.

TABLE II

DESCRIPTION OF TEST VEHICLES - LOW-TEMPERATURE PHASE

<u>Make</u>	<u>Model (1)</u>	<u>Eng. Displ. (liters)</u>	<u>Fuel System (2)</u>
Pontiac	Grand Prix	3.8	Carb
Oldsmobile	Ciera	2.8	Carb
Chevrolet	Caprice	5.0	Carb
Plymouth	Horizon	2.2	Carb
Chrysler	Fifth Avenue	5.2	Carb
Ford	Escort	1.9	Carb
Honda	Accord	2.0	Carb
Toyota	Corolla	1.6	Carb
Ford	Bronco	4.9	Carb
Oldsmobile	Ciera	2.5	TBI
Pontiac	Sunbird	1.8	TBI
Chevrolet	Astro (Van)	4.3	TBI
Chevrolet	Cavalier	2.0	TBI
Ford	Tempo	2.3	TBI
Ford	Thunderbird	3.8	TBI
Dodge	Aries	2.2	TBI
Dodge	Aries	2.5	TBI
Renault	Alliance	1.7	TBI
Oldsmobile	Delta 88	3.0	PFI
Oldsmobile	Delta 88	3.8	PFI
Chevrolet	Camaro	2.8	PFI
Chevrolet	Camaro	2.8	PFI
Mercury	Sable	3.0	PFI
Lincoln	Continental	5.0	PFI
Chrysler	LeBaron (Turbo)	2.2	PFI
Volkswagen	Jetta	1.8	PFI
Toyota	Camry	2.0	PFI

(1) 1986 model year vehicles.

(2) Carb = carburetted
PFI = port fuel injected
TBI = throttle body injected

TABLE III
SUMMARY OF TEST FUEL PROPERTIES

Fuel No.	Hydrocarbon-Only					Hydrocarbon + 10 Vol. % Ethanol					Hydrocarbon + 9.5 Vol. % Methanol:TBA (1:1)				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
IBP	82	85	91	86	88	86	104	99	82	91	86	114	108	86	96
5	100	126	124	102	116	99	130	127	99	116	103	134	131	106	116
10	110	143	144	113	127	112	136	139	112	129	110	142	143	115	126
20	125	165	174	129	147	126	144	151	127	143	120	164	174	128	138
30	146	180	200	152	170	138	150	160	144	152	134	180	204	148	166
40	172	193	218	188	196	150	176	211	158	167	163	190	215	191	196
50	202	204	228	229	214	194	204	228	234	211	200	197	230	227	214
60	216	215	238	244	224	214	216	244	253	222	219	204	242	241	226
70	230	233	252	258	237	224	234	265	264	232	232	216	258	254	239
80	259	270	282	284	271	250	264	314	282	250	261	240	289	277	269
90	368	316	364	317	344	364	315	364	324	344	368	310	370	319	342
95	378	328	378	328	358	378	326	378	352	371	377	326	384	346	363
EP	402	352	400	348	396	398	346	395	382	404	400	362	403	378	382
Rec.	98.2	98.1	98.2	98.6	98.6	96.4	98.8	97.6	97.0	97.7	98.5	99.1	97.6	97.8	97.2
Res.	1.0	1.0	0.7	0.9	1.0	1.0	1.0	1.0	1.3	1.0	1.0	0.7	1.3	1.2	1.4
Loss	0.8	0.9	1.1	0.5	0.4	2.6	0.2	1.4	1.7	1.3	0.5	0.2	1.1	1.0	1.4
RVP, psi	11.3	8.7	9.0	11.0	9.4	12.8	8.0	8.7	13.3	10.3	12.1	8.5	9.2	12.0	10.4
T _{V/L=20}	121.2	145.2	148.7	122.0	134.0	110.8	141.7	141.8	110.0	125.0	112.0	120.8	134.2	114.2	123.0

Note: Underlined test fuel properties do not meet specifications in the proposed program (Appendix B).

TABLE IV

DISTRIBUTION OF RUN AND SOAK TEMPERATURES

Intermediate-Temperature Phase

RUNTEMP	FREQUENCY	PERCENT	CUMULATIVE FREQUENCY	CUMULATIVE PERCENT
31 TO 40	42	9.0	42	9.0
41 TO 50	244	52.0	286	61.0
51 TO 60	182	38.8	468	99.8
61 TO 70	1	0.2	469	100.0

SOAKTEMP	FREQUENCY	PERCENT	CUMULATIVE FREQUENCY	CUMULATIVE PERCENT
21 TO 30	26	5.5	26	5.5
31 TO 40	239	51.0	265	56.5
41 TO 50	178	38.0	443	94.5
51 TO 60	26	5.5	469	100.0

Low-Temperature Phase

RUNTEMP	FREQUENCY	PERCENT	CUMULATIVE FREQUENCY	CUMULATIVE PERCENT
-10 TO 0	34	7.0	34	7.0
1 TO 10	17	3.5	51	10.5
11 TO 20	107	22.0	158	32.5
21 TO 30	228	46.9	386	79.4
31 TO 40	85	17.5	471	96.9
41 TO 50	15	3.1	486	100.0

SOAKTEMP	FREQUENCY	PERCENT	CUMULATIVE FREQUENCY	CUMULATIVE PERCENT
-10 TO 0	28	5.8	28	5.8
1 TO 10	57	11.7	85	17.5
11 TO 20	240	49.4	325	66.9
21 TO 30	134	27.6	459	94.4
31 TO 40	27	5.6	486	100.0

TABLE V
COLD-START AND WARMUP DRIVEABILITY DEMERITS*

(INTERMEDIATE-TEMPERATURE PHASE)

FUEL: CARB	Hydrocarbon-Only					Hydrocarbon + 10 Vol. % Ethanol					Hydrocarbon +9.5 Vol. % Methanol:TBA (1:1)					Average
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
17	62	19	49	12	34	1	78	0	55	13	32	0	127	0	9	33
19	32	1	64	73	12**	8	122	72	130	114	110	12	159	134	73	74
21	48	16	69	16	20	43	24	81	48	72	65	55	84	88	50	52
22	17	174	84	127	116	42	53	55	89	168	128	108	150	86	206	107
23	108	122	133	222	214	67	128	436	180	240	112	395	384	355	204	220
24	3	10	51	25	24	9	52	33	18	7	19	107	85	72	68	39
25	4	47	128	29	70	2	68	12	106	40	164	98	159	66	58	70
26	18	50	98	33	79	108	58	144	85	36	91	48	39	47	106	69
27	127	36	99	104	65	104	88	69	54	90	75	83	36	69	57	77
AVG.	46	53	86	71	70	43	75	100	85	87	88	101	136	102	92	82

TBI

1	7	0	9	0	24	18	17	63	16	4	0	31	27	0	34	17
2	18	10	24	21	14	46	24	59	12	58	24	56	80	84	60	39
3	3	12	65	27	64	0	53	40	101	46	36	24	144	23	38	45
4	19	0	9	51	24	4	3	4	12	16	0	9	66	28	24	18
5	8	21	139	36	62	154	198	350	**	51	47	154	159	183	114	120
7	2	49	0	41	36	47	31	24	16	10	21	4	31	39	40	26
8	55	18	77	71	49	64	28	125	86	104	218	81	227	56	42	87
9	61	23	121	6	60	5	42	107	58	36	66	85	162	24	26	59
20	8	0	24	0	30	24	9	31	14	6	0	18	33	4	36	16
AVG.	20	15	52	28	40	40	45	89	39	37	46	51	103	49	46	47

* Only data used in regression analyses are shown. Averages of duplicate tests are shown for Fuels 5, 10, and 15.
** Outlier deleted in regression analysis.

TABLE V - (Continued)
COLD-START AND WARMUP DRIVEABILITY DEMERITS*

(INTERMEDIATE-TEMPERATURE PHASE)

FUEL: PFI	Hydrocarbon-Only					Hydrocarbon + 10 Vol. % Ethanol					Hydrocarbon +9.5 Vol. % Methanol:TBA (1:1)					Average
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
10	2	27	8	0	32	84	0	96	14	19	43	102	37	54	33	37
11	14	0	58	30	88	21	94	66	158	71	242	29	149	120	82	81
12	0	43	60	0	25	56	30	119	21	4	0	80	156	0	58	43
13	0	6	36	0	10	7	4	3	0	8**	44	5	23	16	24	12
14	0	29	24	0	16	0	1	16	8	20	14	0	52	24	13	14
15	15	5	18	57	9	9	5	9	15	38	8	16	59	6	28	20
16	28	10	14	24	12	12	6	4	12	50	3	22	94	20	12	22
18	1	25	18	10	20	50	4	62	7	19	6	3	6	27	32	19
AVG.	8	18	30	15	26	30	18	47	29	29	45	32	72	33	35	31
FLEET																
AVERAGE	25	29	57	39	46	38	47	80	53	52	60	62	105	62	59	54

* Only data used in regression analyses are shown. Averages of duplicate tests are shown for Fuels 5, 10, and 15.
** Outlier deleted in regression analysis.

TABLE VI
COLD-START AND WARMUP DRIVEABILITY DEMERITS*

(LOW-TEMPERATURE PHASE)

FUEL: CARB	Hydrocarbon-Only					Hydrocarbon + 10 Vol. % Ethanol					Hydrocarbon +9.5 Vol. % Methanol:TBA (1:1)					Average
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
59	7	174	215	98	144	102	263	238	220	231	93	124	523	184	238	190
60	85	70	103	80	175	217	158	310	210	74	173	253	106	156	165	156
61	184	117	344	169	128	224	140	261	151	284	260	198	402	407	131	227
63	100	72	246	66	147	203	64	**	67	63	102	288	251	216	142	145
64	99	314	176	215	234	88	176	349	308	250	359	244	323	175	247	237
65	75	309	162	100	172	230	162	342	43	147	77	153	51	177	134	156
66	146	103	106	171	92	65	96	168	17	159	90	73	15	94	101	100
67	171	93	234	218	144	81	360	106	279	121	182	80	200	62	98	162
68	8	69	95	13	93	159	50	179	56	29	32	18	18	86	75	65
AVG.	97	147	187	126	148	152	163	244	150	151	152	159	210	173	148	160
TBI																
41	9	66	36	17	92	184	62	277	51	42	18	170	66	44	51	79
42	92	112	222	154	78	85	46	171	22	196	200	105	203	259	52	133
43	6	52	119	23	42	64	132	71	166	91	21	70	328	84	215	99
44	61	18	166	59	103	60	19	70	39	20	22	278	143	150	54	84
45	28	123	80	42	160	51	41	43	227	68	190	165	216	208	162	120
46	158	15	78	128	76	61	8	155	112	3	110	104	215	73	186	99
47	186	157	70	213	102	53	68	132	60	179	76	197	159	92	41	119
48	91	37	235	188	144	41	222	70	223	74	83	36	155	26	65	113
49	62	127	133	64	128	163	98	195	11	73	19	115	127	165	101	105
AVG.	77	78	126	99	103	85	77	132	101	83	82	138	179	122	103	106

* Only data used in regression analyses are shown. Averages of duplicate tests are shown for Fuels 5, 10, and 15.

TABLE VI - (Continued)
COLD-START AND WARMUP DRIVEABILITY DEMERITS*

(LOW-TEMPERATURE PHASE)

FUEL: PFI	Hydrocarbon-Only					Hydrocarbon + 10 Vol. % Ethanol					Hydrocarbon +9.5 Vol. % Methanol:TBA (1:1)					Average
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
50	43	36	148	50	85	161	58	105	21	108	160	101	107	248	47	98
51	26	82	**	117	19	17	146	87	119	70	92	20	281	84	159	94
52	4	96	64	28	96	156	52	193	57	20	15	129	134	15	118	78
53	16	93	76	25	128	81	134	**	100	73	142	40	73	154	93	88
54	163	46	77	232	64	89	15	**	142	44	154	91	334	89	208	125
55	19	5	136	14	58	146	9	25	16	42	9	225	52	68	50	58
56	62	29	304	69	96	31	201	28	227	84	58	32	54	13	52	89
57	34	208	68	64	118	229	93	260	139	83	82	38	26	70	105	108
58	94	62	15	126	40	30	15	90	10	101	22	88	78	85	17	58
AVG.	51	73	111	80	78	104	80	113	92	69	82	85	126	92	94	88
FLEET AVERAGE	75	99	143	102	110	114	107	164	114	101	105	127	172	129	115	118

* Only data used in regression analyses are shown. Averages of duplicate tests are shown for Fuels 5, 10, and 15.
** Outlier deleted in regression analysis.

TABLE VII

ANALYSIS OF VARIANCE

DEPENDENT VARIABLE SQUARE ROOT TWD

TO DETERMINE SIGNIFICANCE OF VEHICLE, FUEL, AND RATER

<u>SOURCE</u>	<u>DF</u>	<u>F</u>	<u>CONFIDENCE LEVEL, %</u>
Vehicle	52	13.4	99.9
Fuel	14	26.1	99.9
Rater	3	135.0	99.9

TO DETERMINE SIGNIFICANCE OF FUEL TYPE, FUELS WITHIN FUEL TYPE,
VEHICLE FUEL SYSTEM, VEHICLES WITHIN FUEL SYSTEM, RATER, AND RUN
TEMP

<u>SOURCE</u>	<u>DF</u>	<u>F</u>	<u>CONFIDENCE LEVEL, %</u>
Fuel Type	2	16.8	99.9
Fuel (Fuel Type)	12	13.0	99.9
Fuel System	2	13.7	99.9
Vehicle (System)	50	21.9	99.9
Rater	3	137.0	99.9
Run Temperature	1	10.7	99.9

TABLE VIII

COMPARISON OF TOTAL WEIGHTED DEMERITS (TWD'S) OBSERVED IN 1984 CRC INTERMEDIATE-TEMPERATURE PROGRAM WITH THOSE PREDICTED FROM THE 1986/1987 CRC PROGRAM INTERMEDIATE-TEMPERATURE TWD EQUATION - EQUATION 2

SUBPROGRAM A: 12 CARS (9 CARB, 3 FI)							
FUEL NO	DISTILLATION			OBSERVED PERFORMANCE		PREDICTED	
	T ₁₀	T ₅₀	T ₉₀	CARB	FI	TWD EQUATION 2	
				TWD	TWD	CARB	FI*
*** Hydrocarbon-only Fuels ***							
1	135	249	341	70	31	93	41
2	121	220	317	29	9	56	19
*** 10 vol% Gasoline-Ethanol Blends ***							
7	134	243	338	84	42	102	66
8	121	206	316	43	10	60	24
SUBPROGRAM B AND C: 24 CARS (18 CARB, 6 FI)							
*** Hydrocarbon-only Fuels ***							
1	135	249	341	81	26	93	41
2	121	220	317	52	12	56	19
*** 9.5 vol% Gasoline-Methanol:TBA Blends ***							
11	128	242	339	123	46	120	69
12	119	213	316	76	19	87	36

* a fuel-injected prediction for a fleet 2/3 TBI and 1/3 PFI, corresponding to the 1984 test fleet mix.

-30-
FIGURE 1

TEST SITE:
INTERMEDIATE-TEMPERATURE PHASE

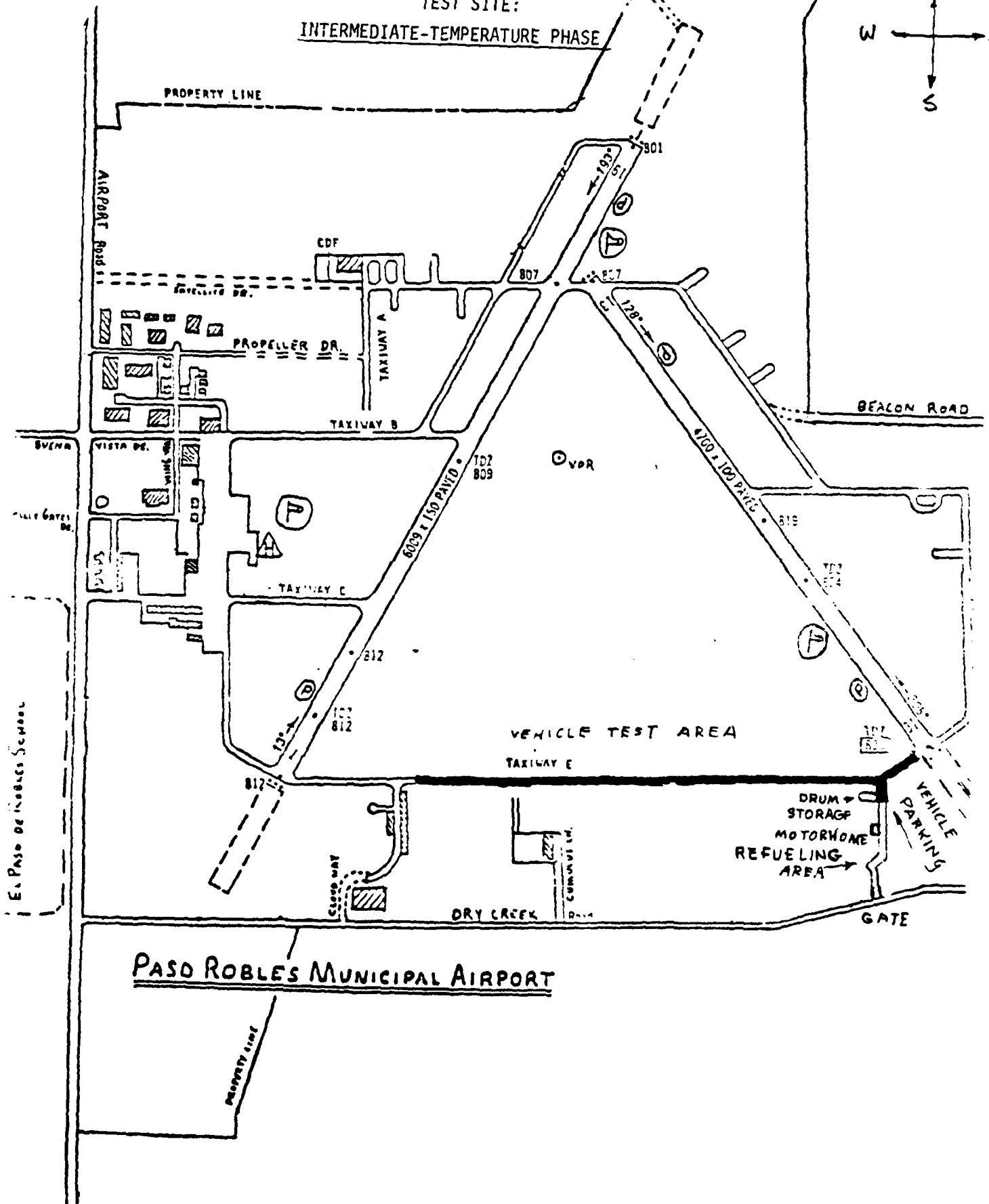
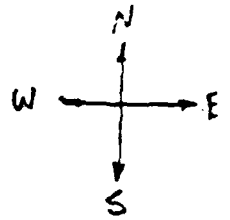
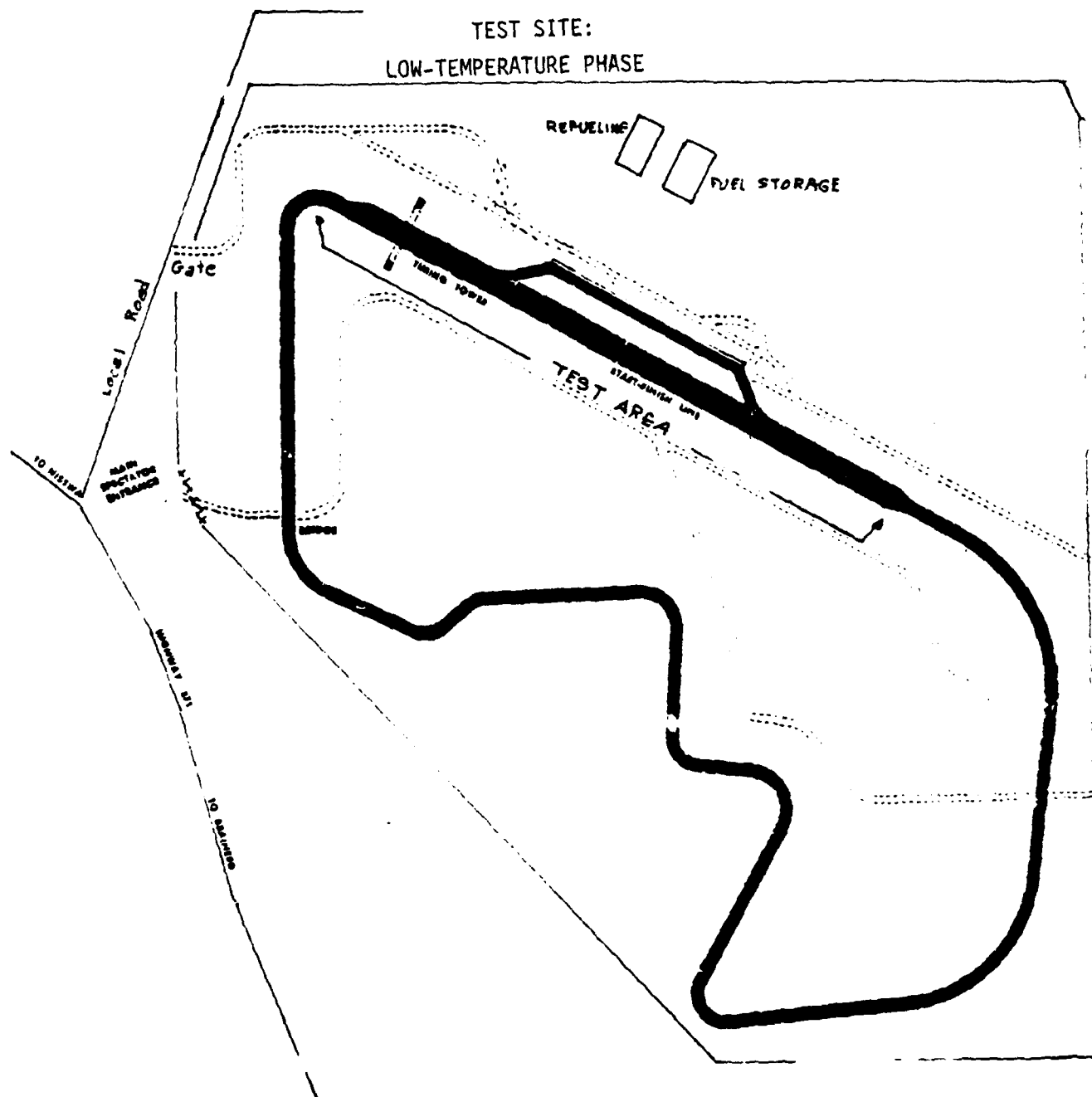


FIGURE 2

TEST SITE:
LOW-TEMPERATURE PHASE



BRainerd INTERNATIONAL RACEWAY

Figure 3

INTERMEDIATE TEMPERATURE PREDICTED TWD Square-Root TWD Regression - Equation 1

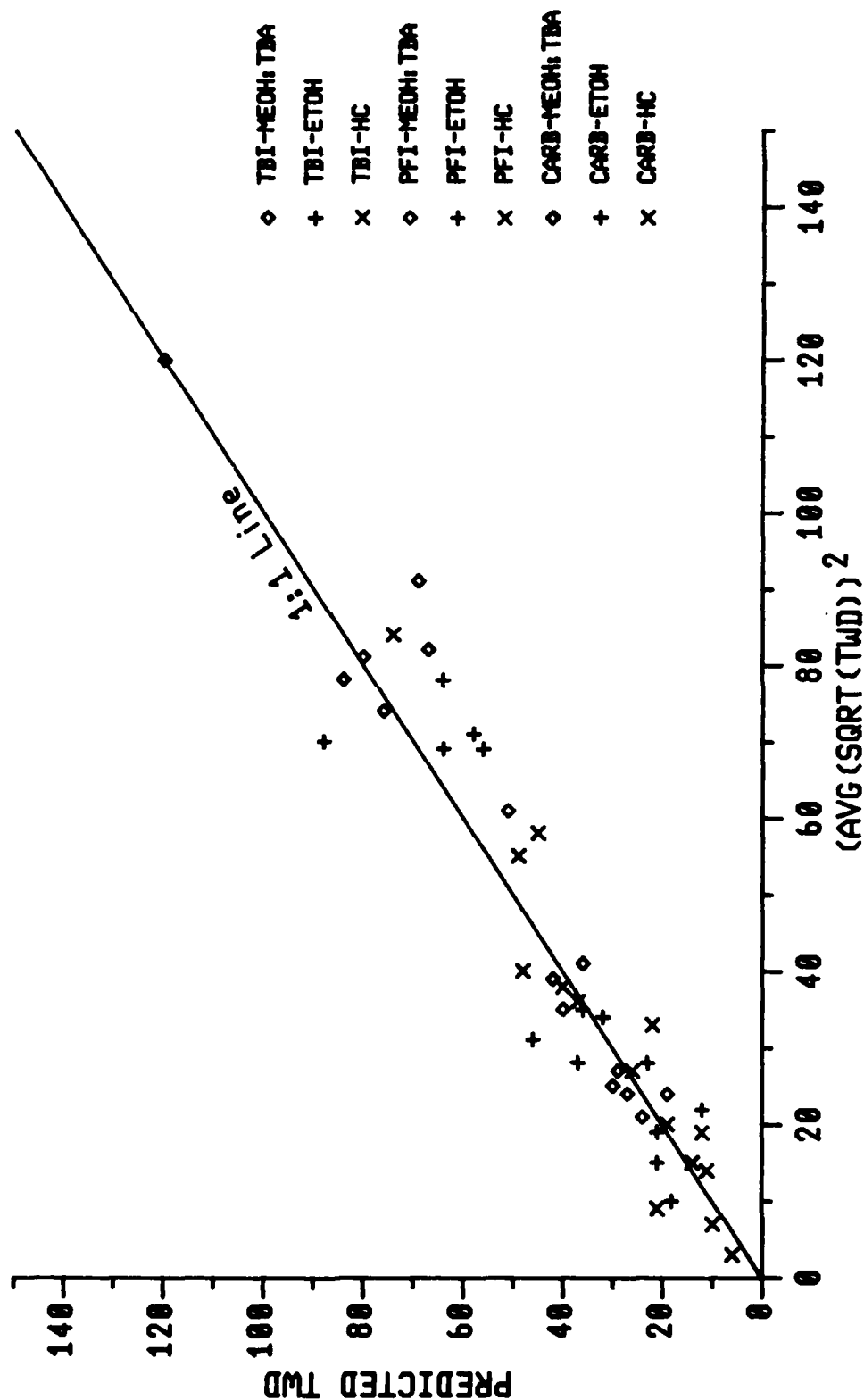


Figure 4

LOW TEMPERATURE PREDICTED TWD Square-Root TWD Regression - Equation 1

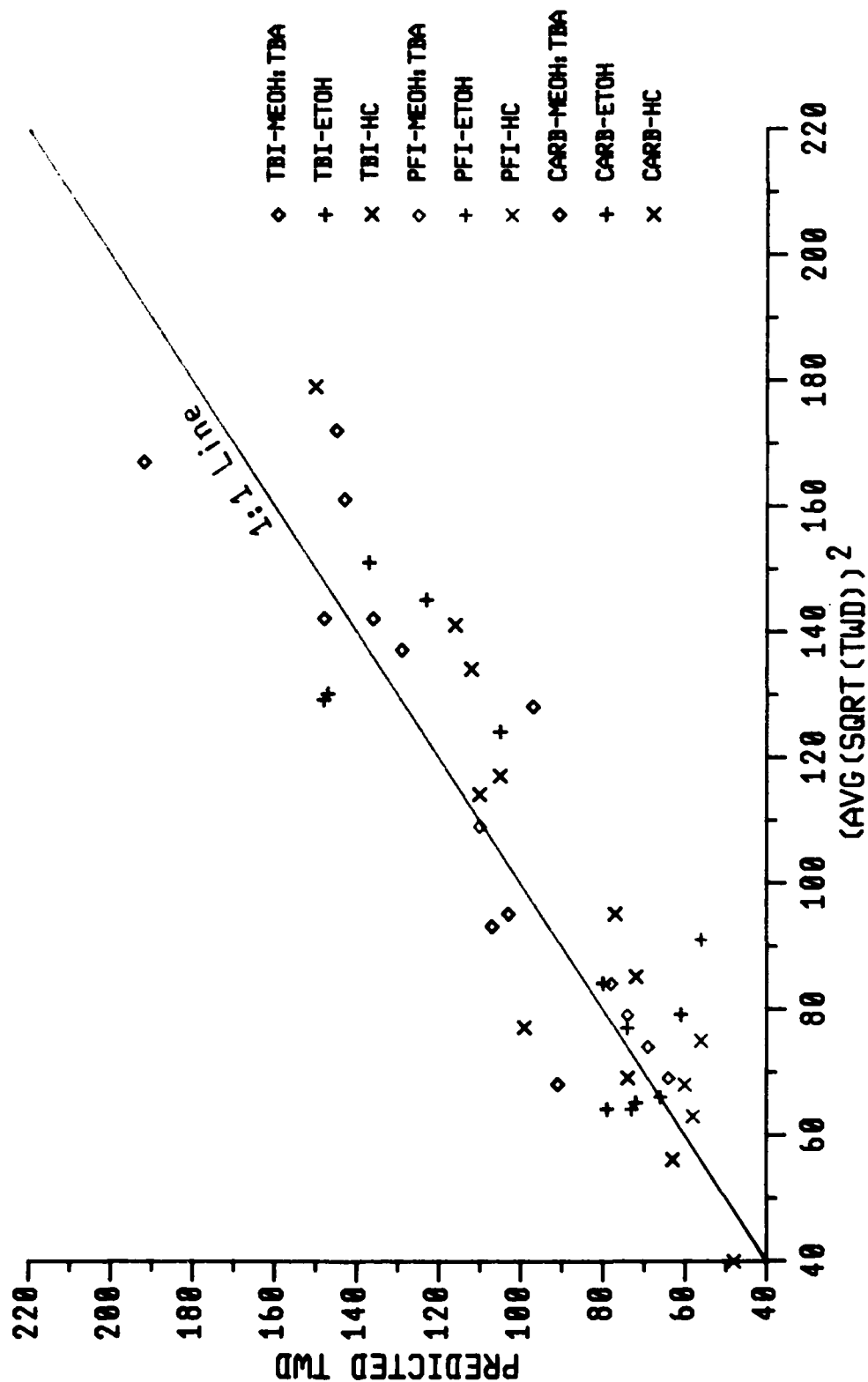


Figure 5

INTERMEDIATE TEMPERATURE Regression versus TWD - Equation 2

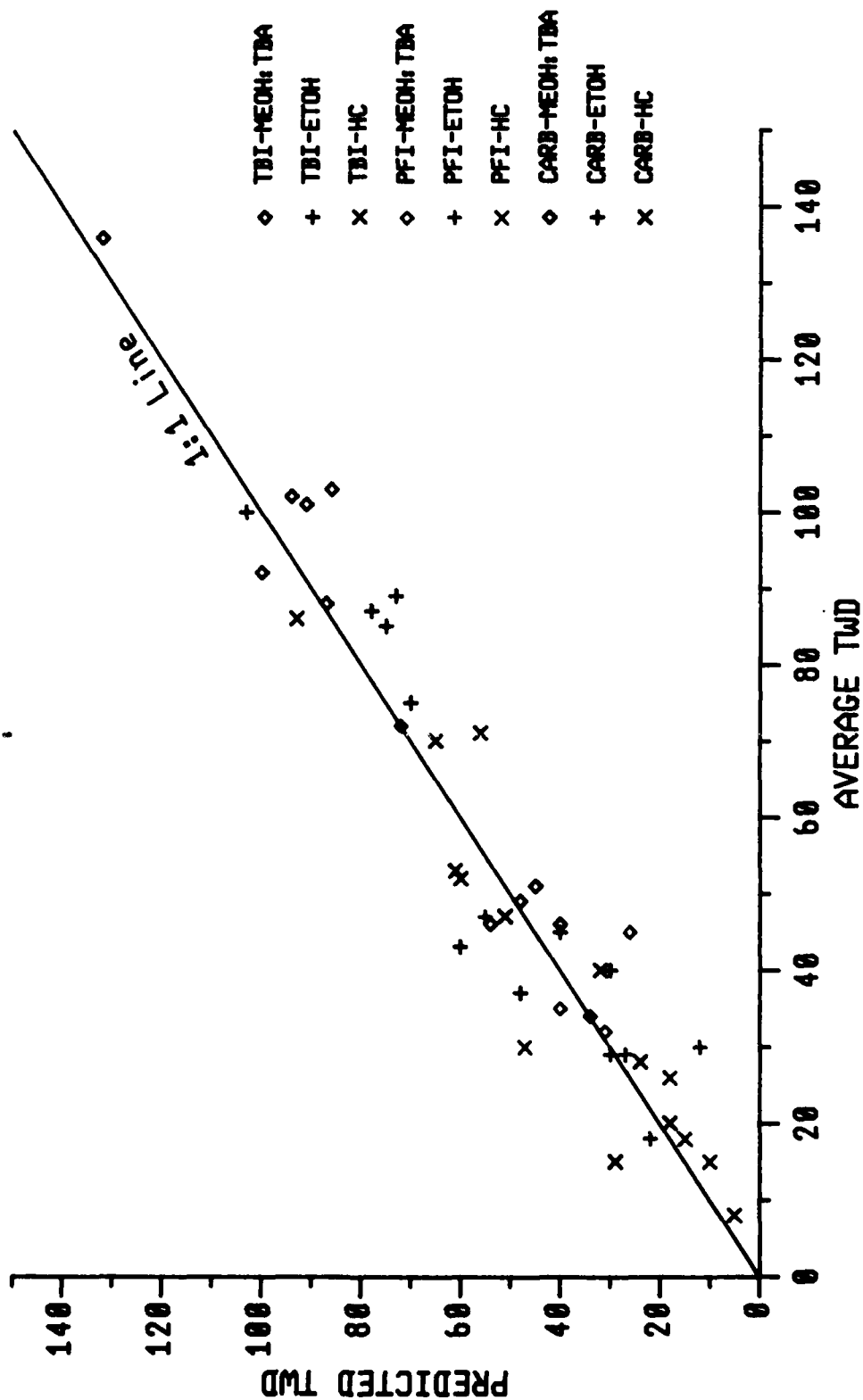


Figure 6

LOW TEMPERATURE Regression versus TWD - Equation 2

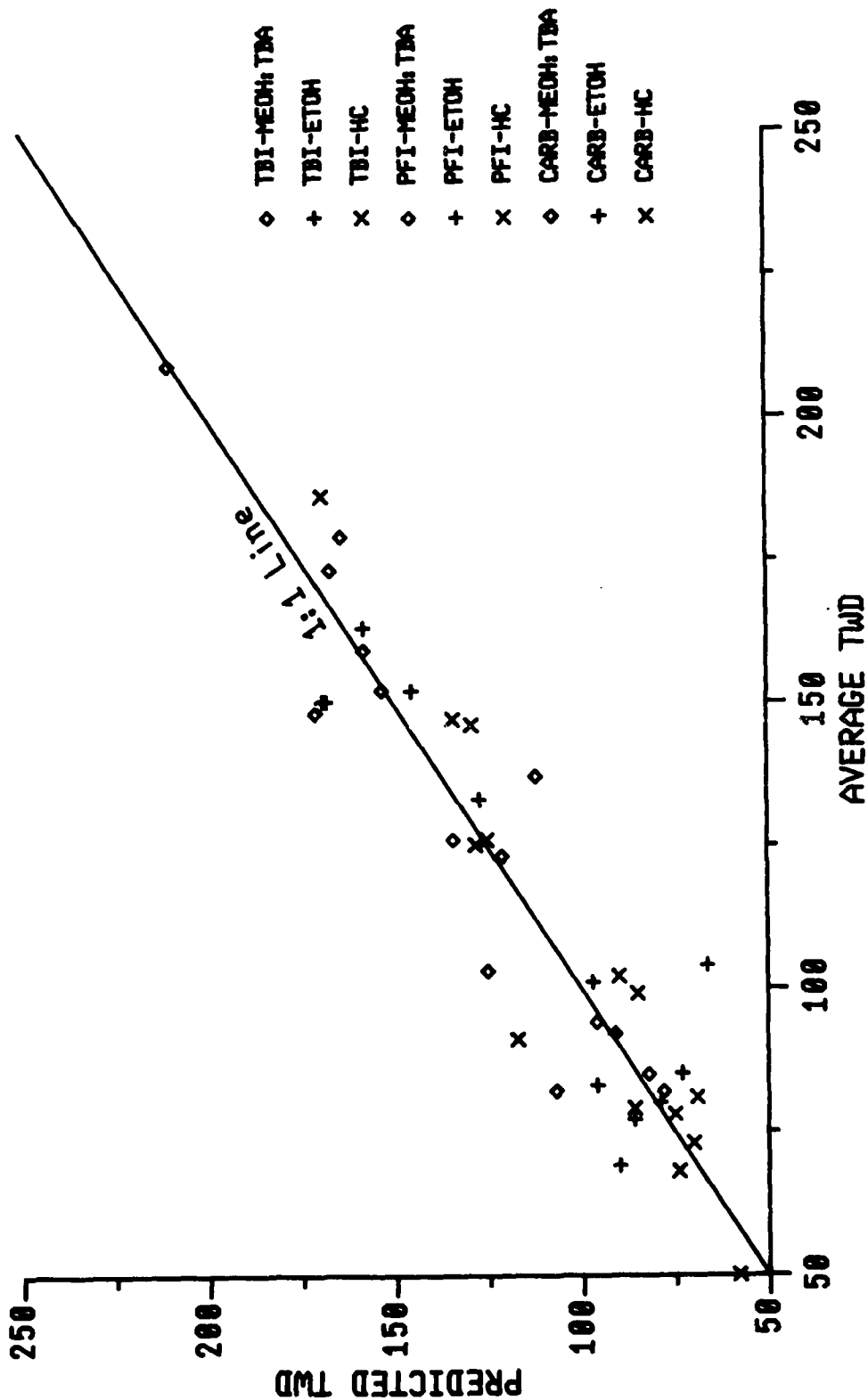


FIGURE 7

Predicted TWD Values (Equation 2) versus Average Observed TWD Values

1984 PROGRAM CARBURETED CARS

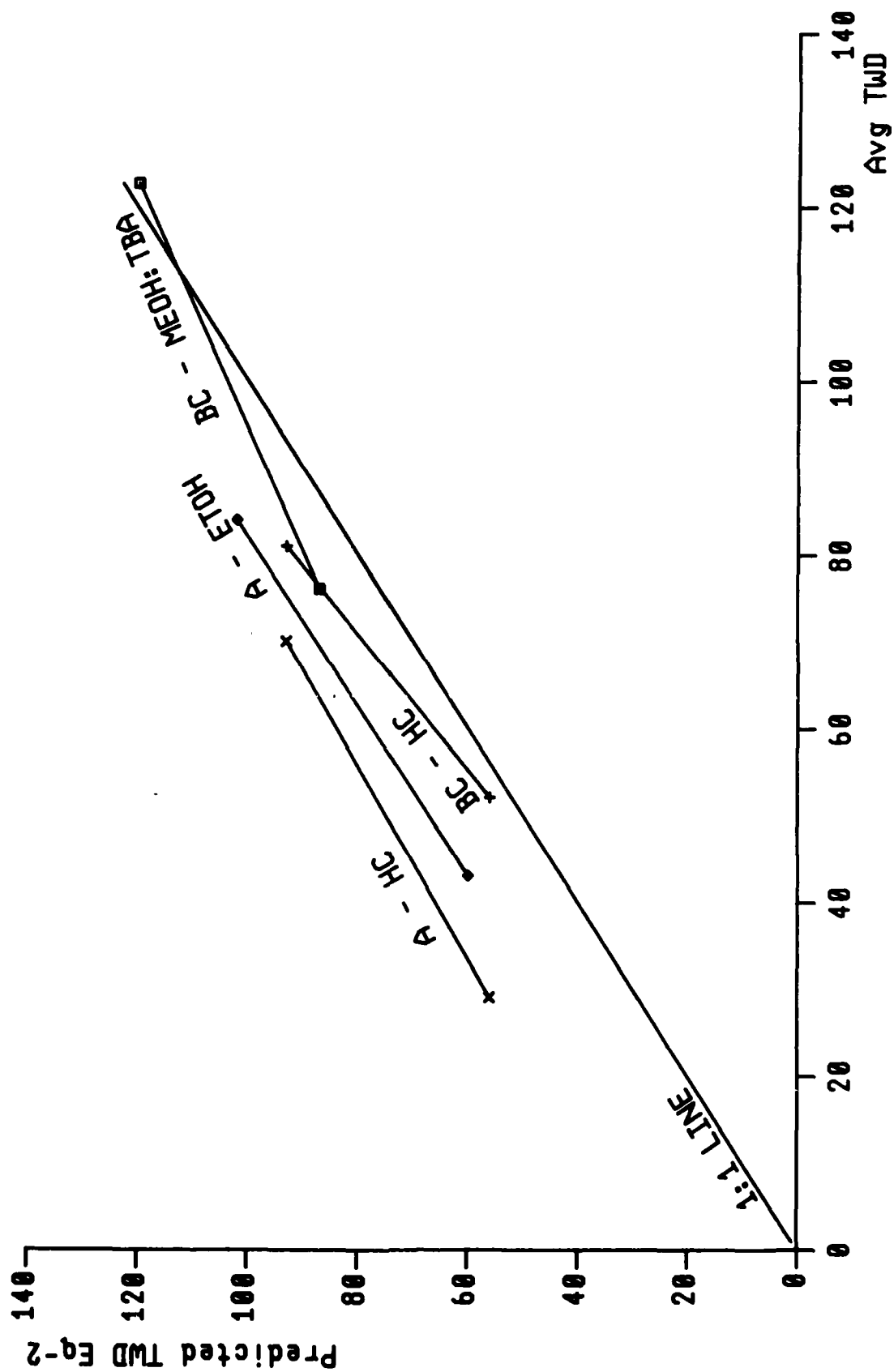
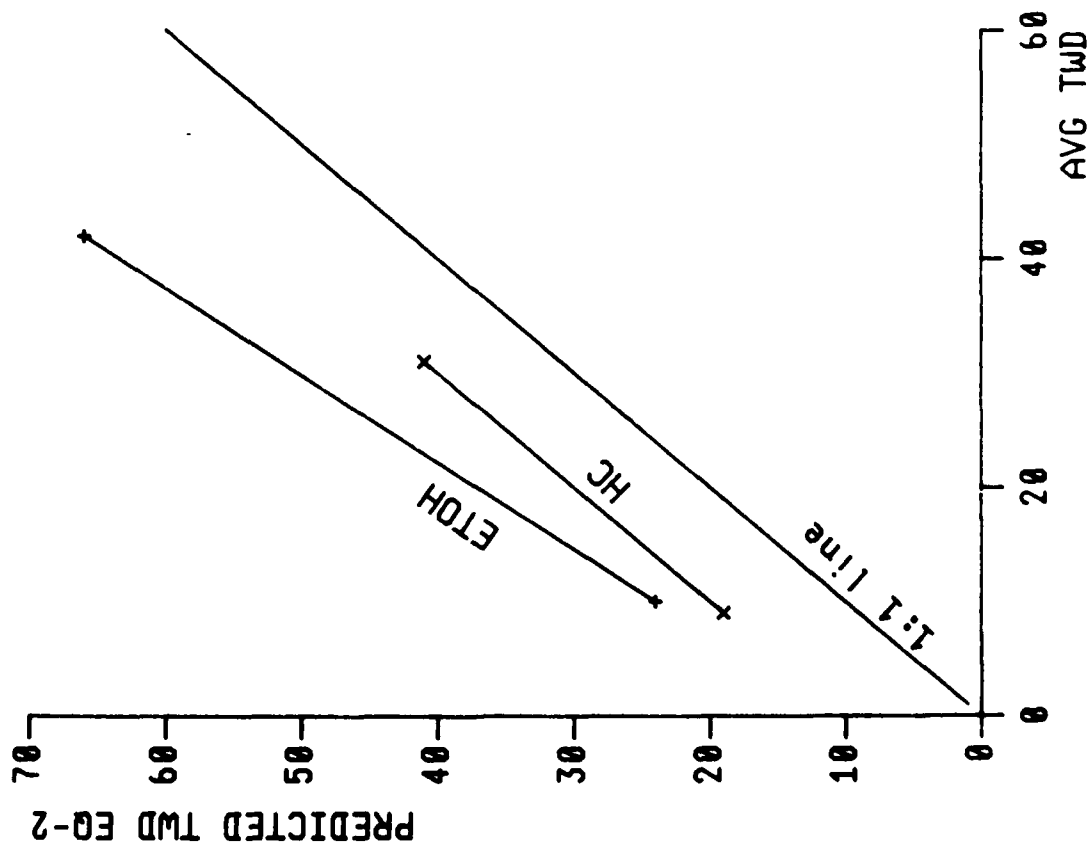


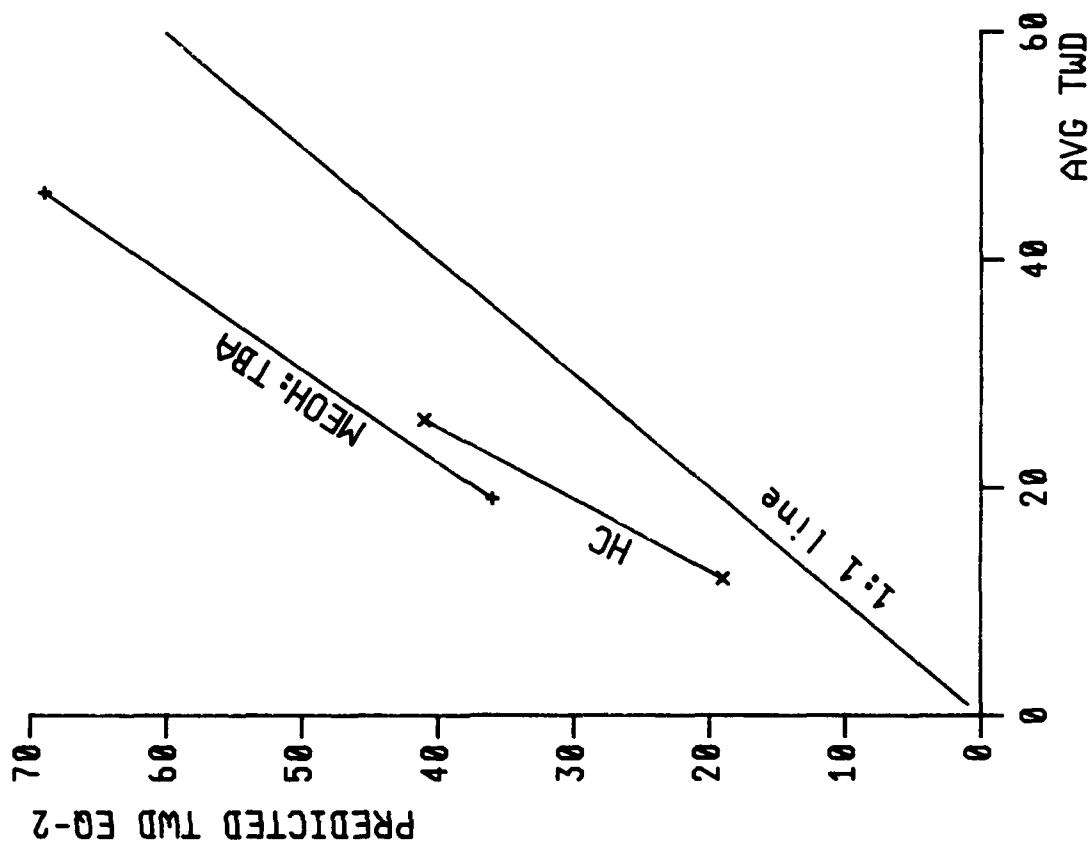
FIGURE 8

Predicted TWD Values (Equation 2) versus Average Observed TWD Values

1984 SUBPROGRAM A
FI CARS



1984 SUBPROGRAM B & C
FI CARS



A P P E N D I X A

**PROGRAM PARTICIPANTS
AND
ANALYSIS PANEL MEMBERSHIP**

1986/1987 CRC LOW- AND INTERMEDIATE-TEMPERATURE DRIVEABILITY PROGRAMPARTICIPATION AND ANALYSIS PANEL MEMBERSHIP

<u>Name</u>	<u>Company</u>	<u>Participation: Intermediate- Temperature Phase</u>	<u>Participation: Low- Temperature Phase</u>	<u>Membership: Analysis Panel</u>
Dave Barker	Shell Development Co.	X	X	X
John Deffner	Chevron Research Co.		X	
Jimmy Douglass	Shell Development Co.		X	
King Eng	Texaco Inc.	X		
Beth Evans	Coordinating Res. Council		X	X
Art Feyers	Chrysler Motors Corp.		X	
John Graham	Chevron Research Co.	X	X	X
Dave Hansen	GM Research Laboratories		X	
Tom Hayden	Texaco Inc.	X		
Brian Kieffer	Auto Research Laboratories		X	
Alan Leard, Ldr.	Amoco Oil Company	X	X	X
Vance McCabe	GM Research Laboratories		X	
Sandy Minner	Unocal Corporation	X		
Gus Mitsopoulos	GM Research Laboratories	X		
Doug Rathe	Shell Development Co.	X	X	
R. M. Reuter	Texaco, Inc.			X
Jim Rolland	Chrysler Motors Corp.	X		
Shuji Sakakibara	Toyota Motor Company	X		
Peter Sarvos	Shell Canada Ltd.		X	
E. Schanerberger	Ford Motor Company	X	X	X
Lieu Steinke	Sun R&M Company	X	X	X
John Steury	Amoco Oil Company			X
Linda Sumansky	Mobil R&D Corp.	X	X	X
Takao Tate	Toyota Motor Company	X		
Chuck Valade	Chrysler Motors Corp.	X	X	X
Andy Vukovic	Shell Canada Ltd.		X	
Ed Willis	Sun R&M Company	X		
Phil Yaccarino	GM Research Laboratories	X		

A P P E N D I X B

**1986/1987 CRC LOW- AND INTERMEDIATE-TEMPERATURE
DRIVEABILITY PROGRAM USING GASOLINE-ALCOHOL BLENDS**

B-1

COORDINATING RESEARCH COUNCIL
INCORPORATED

219 PERIMETER CENTER PARKWAY
ATLANTA, GEORGIA 30346
(404) 396-3400

Not to be Published

1986/1987 CRC VOLATILITY PROGRAM
ON THE
EFFECT OF ALCOHOL FUELS ON DRIVEABILITY AT
LOW AND INTERMEDIATE AMBIENT TEMPERATURES

(CRC Project No. CM-118-86/87)

Prepared by the
CRC-Automotive Volatility Group

September 1986

CRC-AUTOMOTIVE 1986/1987 VOLATILITY PROGRAM

EFFECT OF ALCOHOL FUELS ON DRIVEABILITY AT

LOW AND INTERMEDIATE AMBIENT TEMPERATURES

Objective

The objectives of the 1986/1987 CRC Volatility Group program are:

1. Characterize the relationship between driveability and the 10, 50, and 90% distillation temperatures for hydrocarbon-only and hydrocarbon/alcohol blends.
2. Develop a driveability equation for both hydrocarbon-only and hydrocarbon/alcohol blends for intermediate ambient temperatures, and another for low temperatures. Possibly, the two equations will be combined using a temperature term.
3. Evaluate the driveability index equation independently using data from other programs.

Introduction

Several previous CRC programs have been conducted to determine the effect of fuel volatility on cold start and warmup driveability. However, only one of these programs has been run using hydrocarbon/alcohol blends. The 1984 CRC Volatility Group program was run at intermediate ambient temperatures (40-60°F) and was designed to take a broad look at possible fuel parameters which may influence cold start/warmup driveability. The fuel set design used in the 1984 program, however, was not conducive to development of a driveability equation.

The ultimate goal of this program is to develop a driveability equation as a function of 10, 50, and 90% distillation temperatures, compositional parameters, and ambient temperature. The term compositional parameters refers very specifically to the three fuel compositions: 1) hydrocarbon-only; 2) hydrocarbon + 10 vol.% ethanol; and 3) hydrocarbon + 9.5 vol.% methanol:TBA (1:1).

Test Temperatures

Target minimum test temperatures are 0°F and 40°F for the low- and intermediate-temperature phases, respectively. Tests will be conducted as near as possible to these minimum target temperatures. However, due to daily ambient temperature fluctuations, actual ranges of test temperature will probably be about 0 to 20°F for the low-temperature phase and 40 to 60°F for the intermediate-temperature phase.

Test Fuels

The test fuels will consist of three fuel compositions [hydrocarbon-only, hydrocarbon + 10 vol.% ethanol, and hydrocarbon + 9.5 vol.% methanol:TBA (1:1)]. The fuels will provide independent variation in three volatility parameters, 10% distillation temperature, 50% distillation temperature, and 90% distillation temperature.

The fuel set design would require fifteen fuels (five for each of the three fuel compositions). The test fuel specifications are shown in Table B-I. The test fuel quantities are shown in Table B-II.

The following inspections will be provided by the fuel supplier:

- Rvp, psi (Dry Method, Modification of D 323)
- Distillation (D 86)
- API Gravity (D 287)
- T_v/L=20 (Hg Modification of D 2533)
- FIA (Base Fuels)
- Alcohol Content, vol.% (GC)
- Calculated Latent Heat of Vaporization
- Net Heating Value (Modified D 240)

Test fuels will be provided to any laboratory or organization that desires to measure fuel properties.

Test Vehicles

Tests will be conducted with twenty-eight 1986 model year cars and light trucks. To emphasize future fuel system/engine combinations, eight of the vehicles will be throttle-body fuel-injected, ten will be port fuel-injected, and ten will be carburetted. All vehicles are to be equipped with automatic transmissions. The proposed vehicle list is shown in Table B-III.

Vehicle preparation will include:

- 1) Thorough mechanical inspection.
- 2) Installation of fuel tank drain.
- 3) Installation of manifold vacuum tap.
- 4) Installation of thermocouple in the fuel tank.

Test Procedure

The test procedure will be the CRC Cold Start and Warmup Driveability Procedure as previously run in 1980. The procedure will be modified by adding two additional cycles. The additional cycles are used to indicate warmed-up driveability malfunctions. This is of particular interest with fuels containing alcohol, and may help to evaluate vehicle problems.

Cold start driveability analysis will be based on the initial six cycles as in previous test programs. The last two cycles will be analyzed separately to indicate warmed-up driveability malfunctions. The test procedure and rating system are included as Attachment A.

Program Duration and Manpower Requirement

As indicated in Table B-IV each test phase should last about four and one-half weeks. Nine participants are required to be on site at all times; this gives a total manpower requirement of eighty-one man-weeks. It is desirable for continuity and to minimize rater training that raters participate for the full program time of four weeks. Efforts will be made to assign participants to the test phase in which they are most interested.

Test Location and Timing

The intermediate portion of the program will be conducted from October 13, 1986, through November 14, 1986, at the Paso Robles Airport, Paso Robles, California. The facility is paved and will offer access to a local highway for vehicle preparation.

The low-temperature portion of the program will be conducted from January 20, 1987, through February 21, 1987, at Brainerd International Raceway, Brainerd, Minnesota. To provide an ice-free and dry surface, salting and sanding of the track will be allowed. Offices and indoor shop areas are also available for our use.

Test Design

The final test design will be determined when program participants, the number of cars, and test fuels have been finalized.

TABLE B-I

TEST FUEL DESIGN LEVELS

<u>Fuel</u>	<u>10% Dist.</u>	<u>50% Dist.</u>	<u>90% Dist.</u>
HYDROCARBON-ONLY			
1	110	200	370
2	140	200	320
3	140	230	370
4	110	230	320
5	125	215	345
HYDROCARBON + 10 VOL.% ETHANOL			
6	110	200	370
7	140	200	320
8	140	230	370
9	110	230	320
10	125	215	345
HYDROCARBON + 9.5 VOL.% METHANOL:TBA (1:1)			
11	110	200	370
12	140	200	320
13	140	230	370
14	110	230	320
15	125	215	345

1. Tolerances shall be +5°F on distillation temperatures.
2. Minimum delta T_{10} and T_{50} values are also specified as follows:
 - a) T_{10} for Fuels 2 and 3 shall be at least 25°F higher than Fuels 1 and 4.
 T_{50} for Fuels 3 and 4 shall be at least 25°F higher than Fuels 1 and 2.
 - b) T_{10} for Fuels 7 and 8 shall be at least 25°F higher than Fuels 6 and 9.
 T_{50} for Fuels 8 and 9 shall be at least 25°F higher than Fuels 6 and 7.
 - c) T_{10} for Fuels 12 and 13 shall be at least 25°F higher than Fuels 11 and 14.
 T_{50} for Fuels 13 and 14 shall be at least 25°F higher than Fuels 11 and 12.
3. RVP ranges for all fuels are specified according to the 10% distillation temperature.

<u>10% Distillation</u>	<u>RVP, psi</u>
110°F	10.5 - 13.0
125°F	9.0 - 11.5
140°F	7.0 - 9.5

4. All fuels shall be unleaded and have a minimum (R+M)/2 octane rating of 88.
5. Fuel shall exhibit no phase separation at -20°F.
6. Fuels shall contain no more than 4% Benzene.
7. Fuels shall not exceed the ASTM maximum endpoint specification of 437°F.
8. Fuels shall contain an antioxidant and a corrosion inhibitor.

TABLE B-II

TEST FUEL QUANTITIES

<u>Fuel</u>	<u>Number of Drums</u>	<u>Volume, gallons</u>
HYDROCARBON-ONLY		
1	8	440
2	8	440
3	10	550
4	8	440
5	14	770
HYDROCARBON + 10 VOL. % ETHANOL		
6	8	440
7	8	440
8	12	660
9	8	440
10	14	770
HYDROCARBON + 9.5 VOL. % METHANOL:TBA (1:1)		
11	8	440
12	8	440
13	10	550
14	8	440
15	14	770
<hr/>		
Totals	146	8,030

TABLE B-III

TEST VEHICLES

<u>Manufacturer</u>	<u>Displacement</u>	<u>Fuel System</u>
General Motors	2.5 Liter	TBI
General Motors	1.8 Liter	TBI
General Motors	4.3 Liter	TBI
Ford	2.3 Liter	TBI
Ford	3.8 Liter	TBI
Chrysler	2.5 Liter	TBI
Chrysler	2.2 Liter	TBI
AMC	1.7 Liter	TBI
General Motors	3.8 Liter	PFI
General Motors	5.0 Liter	PFI
General Motors	3.0 Liter	PFI
General Motors	2.8 Liter	PFI
Ford	3.0 Liter	PFI
Ford	5.0 Liter	PFI
Chrysler (Turbo)	2.2 Liter	PFI
VW	1.8 Liter	PFI
Nissan	2.0 Liter	PFI
Toyota	2.0 Liter	PFI
General Motors	3.8 Liter	CARB
General Motors	2.8 Liter	CARB
General Motors	5.0 Liter	CARB
General Motors	1.0 Liter	CARB
Chrysler	2.2 Liter	CARB
Chrysler	5.2 Liter	CARB
Ford	1.9 Liter	CARB
Ford	2.3 Liter	CARB
Honda	2.0 Liter	CARB
Toyota Corolla	1.6 Liter	CARB

TABLE B-IV

PROGRAM DURATION AND MANPOWER REQUIREMENTS

<u>Program Duration</u>	<u>Days Required Per Test Phase</u>
Preparation and Driver Selection	6
Testing	18
Weekend and Weather Allowance	8
<hr/>	
Total Days Per Phase	32 (4.5 Weeks)
Total for Entire Program = 2 x 4.5 Weeks = 9 Weeks	

<u>Manpower Requirements</u>	<u>Number Required</u>
Raters	3
Observers	3
Fueling and Supervision	2
Data Handling	1
<hr/>	
Total	9
Total Manpower Requirement = 9 x 9 = 81 Man-Weeks	

ATTACHMENT A

CRC COLD START AND WARMUP DRIVEABILITY PROCEDURE

TEST PROCEDURE AND DATA RECORDING

- A. Record all necessary test information at the top of the data sheet.
- B. Start engine per Owner's Manual Procedure. Record start time.
- C. If engine fails to start after 15 seconds of cranking, stop cranking. Follow Owner's Manual procedure for this situation. Begin cranking and record total cranking time until engine starts.
- D. Record idle quality in "Neutral" or "Park" immediately after start; foot should be removed from accelerator pedal.
- E. If engine stalls, repeat Steps B and C. Record number of stalls and starting time of required restarts.
- F. Allow engine to idle 15 seconds. Apply brakes (right foot), shift to normal drive range, and record idle quality. If engine stalls, restart immediately. Do not record restart time. Record number of stalls. Idle 5 seconds in "Drive".

This completes the start-up portion of the procedure. Note that space on the data sheet has only been provided for two restart times at any idle condition. If three stalls occur at any condition, record the three stalls, restart (without recording time) and proceed to the next scheduled condition.

- G. After 5 seconds in "Drive" (Step F), make a light throttle (Lt. th) acceleration from 0-25 mph at constant throttle opening beginning at the predetermined manifold vacuum.* Cruise at 25 mph. At the 0.2 mile marker open throttle to the detent position and accelerate from 25 to 35 mph at constant throttle in high gear. Decelerate to a stop, and at the 0.3 mile marker make a WOT acceleration from 0 to 35 mph. Decelerate to 10 mph and at mile marker 0.4 accelerate at light throttle from 10 to 25 mph. Definitions of light throttle, detent, and WOT accelerations are attached.

* Marked on vacuum gauge.

- H. During the above maneuvers, observe and record the severity of any of the following malfunctions (see attached definitions):

1. Hesitation
2. Stumble
3. Surge
4. Stall
5. Backfire

Record maneuvering stalls on the data sheet in the appropriate column: accelerating or decelerating.

- I. At the 0.5 mile marker, brake moderately to a stop on the right side of the roadway. Idle for 30 seconds in Drive. Record idle quality and number of stalls.
- J. Perform Steps G, H, and I three times (1.5 miles). The mile marker for the beginning of each maneuver is indicated on the data sheet.
- K. At mile marker 1.5, after completing the 30-second idle, make a crowd acceleration (constant predetermined vacuum) from 0-45 mph. Four-tenths of a mile is provided for this maneuver. Decelerate from 45 to 25 mph at the 1.9 mile marker, and open throttle to detent position and accelerate from 25 to 35 mph. At 2.0 miles decelerate to a stop and accelerate from 0 to 35 mph at WOT. At 2.1 miles decelerate to 10 mph and accelerate from 10 to 25 mph at light throttle. Rate and record malfunctions in these maneuvers as in Step H. Idle 30 seconds in Drive as in Step I.
- L. Perform Step K five times. Appropriate mile markers for the start of each maneuver are shown on the data sheet.

DEFINITIONS AND EXPLANATIONS

Test Run

Operation of a car throughout the prescribed sequence of operating conditions and/or maneuvers for a single test fuel.

Maneuver

A specified single vehicle operation or change of operating conditions (such as idle, acceleration or cruise) that constitutes one segment of the driveability driving schedule.

Cruise

Operation at a prescribed constant vehicle speed with a fixed throttle position on a level road.

Wide Open Throttle (WOT) Acceleration

"Floorboard" acceleration through the gears from prescribed starting speed. Rate at which throttle is depressed is to be as fast as possible without producing tire squeal or appreciable slippage.

Part-Throttle (PT) Acceleration

An acceleration made an any defined throttle position, or consistent change in throttle position, less than WOT. Several PT accelerations are used. They are:

1. Light Throttle (Lt. Th) - All light throttle accelerations are begun by opening the throttle to an initial manifold vacuum and maintaining constant throttle position throughout the remainder of the acceleration. The vacuum selected is one inch Hg greater than the initial power cut-in vacuum obtained from carburetor flow curves. However, if a 0-25 mph light throttle maneuver (car warmed up) cannot be completed in 0.1 mile, vacuum is decreased in steps of one inch Hg until the 0-25 maneuver can be completed in 0.1 mile. The selected vacuum is posted in each car.
2. Crowd - An acceleration made at a constant intake manifold vacuum. To maintain constant vacuum, the throttle opening must be continually increased with increasing engine speed. Crowd accelerations are performed at the same vacuum prescribed for the light throttle acceleration.
3. Detent - All detent accelerations are begun by opening the throttle to the downshift position as indicated by transmission shift characteristic curves. Manifold vacuum corresponding to this point at 25 mph is posted in each car. Constant throttle position is maintained to 35 mph in this maneuver.

Malfunctions1. Stall

Any occasion during a test when the engine stops with the ignition on. Three types of stall, indicated by location on the data sheet, are:

- a. Stall; idle - Any stall experienced when the vehicle is not in motion, or when a maneuver is not being attempted.
- b. Stall; maneuvering - Any stall which occurs during a prescribed maneuver or attempt to maneuver.
- c. Stall; decelerating - Any stall which occurs while decelerating between maneuvers.

2. Idle Roughness

An evaluation of the idle quality or degree of smoothness while the engine is idling.

3. Backfire

An explosion in the induction or exhaust system.

4. Hesitation

A temporary lack of vehicle response to opening of the throttle.

5. Stumble

A short, sharp reduction in acceleration after the vehicle is in motion.

6. Surge

Cyclic power fluctuations occurring during acceleration or cruise.

Malfunction Severity Ratings

The number of stalls encountered during any maneuver are to be listed in the appropriate data sheet column. Each of the other malfunctions must be rated by severity and the letter designation entered on the data sheet. The following definitions of severity are to be applied in making such ratings.

1. Trace (T) - A level of malfunction severity that is just discernible to a test driver but not to most laymen.
2. Moderate (M) - A level of malfunction severity that is probably noticeable to the average layman.
3. Heavy (H) - A level of malfunction severity that is pronounced and obvious to both test driver and layman.

Enter a T, M, or H in the appropriate data block to indicate both the occurrence of the malfunction and its severity. More than one type of malfunction may be recorded on each line. If no malfunctions occur, enter a dash (-) to indicate that the maneuver was performed and operation was satisfactory during that maneuver.

CRC Driveability Data Sheet

[illegible]

Starting time, sec.		Idle N.		Idle Dr.	
Initial	Restart 1	Restart 2	Restart 3	Ruf. stalls	Ruf. stalls
...

[illegible]

1.5	0.45 Crowd	1.9	25-35 Detent	2.0	0-35 WOT	2.1	10-25 Lt. Th.	2.2	Idle	Temperatures		
Stalls		Stalls		Stalls		Stalls		Stalls		Fuel tank	X1	X2
H	Sig	Br	P	H	Sig	Br	P	H	Sig	Br	P	
2.2		2.6		2.7		2.8		2.9				
2.9		3.3		3.4		3.5		3.6				
3.6		4.0		4.1		4.2		4.3				
4.3		4.7		4.8		4.9		5.0				
												Sample no.

Curriculum

DEMERIT CALCULATION SYSTEM

A numerical value for driveability during the CRC test is obtained by assigning demerits to operating malfunctions as shown on Page B-18. Depending upon the type of malfunction, demerits are assigned in various ways. Demerits for poor starting are obtained by subtracting two seconds from the measured starting time. The number of stalls which occur during idle as well as during driving maneuvers are counted separately and assigned demerits as shown on Page A-7. The multiplying x factors of 8 and 32 for idle and maneuvering stalls, respectively, account for the fact that stalls are very undesirable, especially during car maneuvers.

Other malfunctions, such as hesitation, stumble, surge, idle roughness, and backfire, are rated subjectively by the driver on a scale of trace, moderate, or heavy. For these malfunctions, a certain number of demerits is assigned to each of the subjective ratings. However, since all malfunctions are not of equal importance, the demerits are multiplied by the weighting factors shown on Page A-7 to yield weighted demerits.

Finally, weighted demerits, demerits for stalls, and demerits for poor starting are summed to obtain total weighted demerits (TWD), which are used as an indication of driveability during the test. As driveability deteriorates, TWD increases.

A restriction is applied in the totaling of demerits to insure that a stall results in the highest possible number of demerits within a given maneuver. When more than one malfunction occurs during a maneuver, demerits are counted for only the malfunction which had the largest number of weighted demerits. Another restriction is that for each idle period, no more than 3 idle stalls are counted.

METHOD FOR CALCULATING TOTAL WEIGHTED DEMERITS (TWD)

Demerits for Poor Starting:

$$\text{Demerits} = \text{Starting Time(s)} - 2$$

Demerits for Stalls:

$$\text{Demerits} = (\text{No. of Idle Stalls}) \times 8 + (\text{No. of Maneuvering Stalls}) \times 32$$

Demerits for Malfunctions Rated Subjectively:

Demerits for Subjective Ratings

Trace = 1

Moderate = 2

Heavy = 4

Weighting Factors for Each Malfunction

Idle Roughness = 1

Surge = 4

Backfire, Stumble, Hesitation = 6

Weighted Demerits = Demerits x Weighting Factor

Calculation:

$$\begin{aligned} \text{Total Weighted Demerits} &= \text{Weighted Demerits} + \text{Demerits for Stalls} \\ &+ \text{Demerits for Poor Starting} \end{aligned}$$

NOTE: When more than one malfunction occurs in a driving maneuver, only the malfunction giving the highest weighted demerits is counted.

A P P E N D I X C

TEST SCHEDULE

TEST SCHEDULE
INTERMEDIATE TEMPERATURE PHASE

		DAY																					
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
CAR	RATER																						
1	R	1			4			11		14			10			10							
	S		2			5			12		8			6		15							
	T			3		15			13		9			7		5							
2	R			3		15			13		9			7		5							
	S		1		4			11		14			10		10								
	T			2		5			12		8			6		15							
3	R			2		4		5		12		8			6		15						
	S				3		15			13		9			7		5						
	T			1				11		14			10		10								
4	R		7		10			2		5			11		15								
	S			8		6			3		14			12		5							
	T				9		1			4		15			13		10						
5	R																						
	S				9		1			4		15			13		10						
	T			7		10			2		5			11		15							
	R																						
	S																						
	T																						
7	R																						
	S																						
	T																						
8	R																						
	S																						
	T																						

(CONTINUED)

TEST SCHEDULE
INTERMEDIATE TEMPERATURE PHASE

CAR	WATER	DAY																					
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
9	R	14			12				10		1							10					
	FUEL																						
	S	15			8					6		2		4	5		15						
	T	13			11		9		7			3											
10	R		3		15		13		9														
	FUEL																						
	S			4		11					10												
	T	1	2		5		12		8														
11	R		2		4	5		12		8													
	FUEL																						
	S		3		15		13		9														
	T	1				11					10												
12	R		1		4		11																
	FUEL																						
	S		2		5		12		8														
	T		3		15		13		9														
13	R		9		1		4					15											
	FUEL																						
	S					2				5													
	T		8		10	6		3		14													
14	R		8		6		3																
	FUEL																						
	S		9		1							15											
	T					2				4	5												
15	R		7		10			2			5												
	FUEL																						
	S		8		6		3			14													
	T					1																	

(CONTINUED)

TEST SCHEDULE
INTERMEDIATE TEMPERATURE PHASE

		DAY																					
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
CAR	RATER																						
16	R			15			8			6			2			5			15				
	FUEL																						
	S				11			9			7			3	4		5			13			
	T			14		12			10			1							10				
17	R			14		12			10			1							10				
	FUEL																						
	S			15			8			6			2	4	5				15				
	T			13		11			9			7			3		5						
18	R			13		11			9			7			3		5						
	FUEL																						
	S			14		12			10			1			4		10						
	T				15			8			6			2		5		15					
19	R			2		4	5			12		8			6		15						
	FUEL																						
	S				3		15			13			9			7		5					
	T			1					11		14				10		10						
20	R			1		4			11			14			10		10						
	FUEL																						
	S			2			5			12		8			6		15						
	T				3		15			13			9			7		5					
21	R																						
	FUEL																						
	S				3		15			13			9			7		5					
	T			1		4			11			14			10		10						
22	R			2			5			12		8			6		15						
	FUEL																						
	S				8		6			3		14			12		5						
	T																						

(CONTINUED)

TEST SCHEDULE

INTERMEDIATE TEMPERATURE PHASE

[illegible]

TEST SCHEDULE
LOW TEMPERATURE PHASE

CAR	RATER	DAY																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
41	R																				
	FUEL	1			4			11			14			10						10	
	S		2		5		12					8			6		5		12		
	T												9			7		15			
42	U			3			13														
	R			3			13					9				7		15			
	S		1		4		11				14			10						10	
	T											8			6		5		12		
43	U		2		5		12														
	R		2		5		12					8			6		5		12		
	S			3			13					9				7		15			
	T												10							10	
44	U		1		4		11				14										
	R		7		10		2				5			11						15	
	S		8		6		3					14					5		3		12
	T												15		13		1				
45	U			9						4											
	R			9						4			15		13		1				
	S		7		10		2				5			11						15	
	T											14			12		5		3		
46	U		8		6		3														
	R		8		6		3					14			12		5		3		

(CONTINUED)

TEST SCHEDULE
LOW TEMPERATURE PHASE

CAR	WATER	DAY																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
46	S																				
	FUEL			9						4			15			13		1			
	T										5			11						15	
	U																				
47	FUEL	7		10																	
	R																				
	FUEL	13		11				9			7		3								5
	S																				
48	FUEL	14			12		10					1				10		10		4	
	T																				
	U																				
	FUEL			15						6											
49	R																				
	FUEL			15						6		2				5		8			
	S																				
	T																				
50	U																				
	FUEL	13			11			9													
	R																				
	FUEL			3						13		9				7		15			
51	S																				
	FUEL	1			4		11			14			10								
	T																				
	U																				
51	FUEL			2		5		12													
	R																				
	FUEL			2		5		12													
	S																				

(CONTINUED)

TEST SCHEDULE
LOW TEMPERATURE PHASE

CAR	RATER	DAY																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
51	FUEL													10							10
	FUEL	1			4			11			14										
52	FUEL	1			4			11			14			10							10
	FUEL	2			5			12			8				6	5	12				
													9			7	15				
53	FUEL			3					13												
	FUEL			9					4		15				13		1				
54	FUEL	7			10			2			5			11							15
	FUEL										14				12		5		3		
55	FUEL	8				6		3							12		5		3		
	FUEL			9						4			15			13		1			
56	FUEL													11							15
	FUEL	7			10			2			5										
57	FUEL	7			10			2			5			11							15
	FUEL	8				6		3					14				5		3		12
58	FUEL												15			13		1			
	FUEL			9						4											
59	FUEL																				
	FUEL			15					6		2					5		8			
60	FUEL	13			11			9			7			3							5
	FUEL											1			4		10				

(CONTINUED)

TEST SCHEDULE
LOW TEMPERATURE PHASE

CAR	WATER	DAY																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
56	U		14			12	10														
57	R		14		12	10	10	1	4	10	10										
	S		15				6	2	5	8											
	T							7	3												5
	U		13		11	9															
58	R		13		11	9	7	3													5
	S		14		12	10	1	4	10	10											
	T						2	5	8												
	U		15				6														
59	R		2		5	12	8	6	5	12											
	S		3			13	9	7	15												
	T																				10
	U		1		4	11	14														
60	R		1		4	11	14	10													10
	S		2		5	12	8	6	5	12											
	T						9	7	15												
	U		3				13														
61	R		3				13														
	S		1		4	11	14	10													10
	T																				
	U		2		5	12															

(CONTINUED)

TEST SCHEDULE
LOW TEMPERATURE PHASE

CAR	RATER	DAY																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
63	R	7																			
	FUEL				10			2			5		11								15
	S		8			6		3				14			12		5		3		
	FUEL												15		13						
	T																				
	FUEL																				
	U			9						4											
	FUEL																				
64	R			9																	
	FUEL																				
	S	7			10			2			5		11								15
	FUEL																				
	T											14			12		5		3		
	FUEL																				
	U																				
	FUEL																				
65	R		8			6		3													
	FUEL																				
	S		14			12		10			1			4		10		10			
	FUEL																				
	T			15						6		2			5		8				
	FUEL																				
	U										7		3								5
	FUEL																				
66	R	13			11			9													
	FUEL																				
	S	13			11			9			7		3								5
	FUEL																				
	T		14			12		10			1			4		10		10			
	FUEL																				
	U												2			5		8			
	FUEL																				
67	R			15							6										
	FUEL																				
	S			15							6										
	FUEL																				
	T																				
	FUEL																				
	U																				
	FUEL																				
68	R																				
	FUEL																				
	S																				
	FUEL																				

(CONTINUED)

TEST SCHEDULE

LOW TEMPERATURE PHASE

[illegible]

A P P E N D I X D

INDIVIDUAL LABORATORY
FUEL PROPERTY DATA

TEST FUEL PROPERTIES BY LABORATORIES

HYDROCARBON-ONLY

FUEL NO.	<u>1</u>		<u>2</u>		<u>3</u>		<u>4</u>		<u>5</u>	
LAB. I.D.	A	B	A	B	A	B	A	B	A	B
D 86 Dist. % Evap., °F										
IBP	80	83	81	93	94	88	88	83	88	87
5	98	102	121	130	126	123	103	101	116	115
10	108	112	140	146	146	143	114	112	127	127
20	122	128	164	166	175	173	130	128	146	148
30	145	147	179	181	199	200	152	152	170	171
40	170	174	192	194	217	218	179	196	194	197
50	199	205	203	204	228	229	225	233	212	216
60	211	220	214	216	238	237	242	247	223	226
70	230	231	232	234	251	253	256	259	235	239
80	255	263	267	274	279	285	280	289	272	270
90	367	369	315	318	362	367	313	321	342	345
95	379	378	329	328	377	379	326	330	357	359
EP	414	391	362	343	400	400	340	355	406	385
Rec.	99.0	97.4	98.5	97.6	99.0	97.3	99.0	98.2	99.0	98.2
Res.	1.0	1.0	1.0	1.0	0.5	1.0	0.8	1.0	1.0	1.0
Loss	0.0	1.6	0.5	1.4	0.5	1.7	0.2	0.8	0.0	0.8
RVP, psi	11.4	11.2	8.8	8.6	8.9	9.1	10.9	11.2	9.2	9.6
T _{V/L=20}	121.2		145.2		148.7		122.0		134.0	

TEST FUEL PROPERTIES BY LABORATORIES

HYDROCARBON + 10 VOL.% ETHANOL

FUEL NO.	<u>6</u>		<u>7</u>		<u>8</u>		<u>9</u>		<u>10</u>	
LAB. I.D.	A	B	A	B	A	B	A	B	A	B
D 86 Dist. % Evap., °F										
IBP	82	88	104	103	99	99	82	82	91	91
5	100	98	129	130	125	129	97	101	114	119
10	112	112	136	136	138	140	112	112	129	129
20	128	125	144	144	150	152	128	126	143	143
30	139	138	150	150	160	160	144	143	152	153
40	151	150	174	178	209	213	158	158	167	167
50	195	193	202	205	228	227	230	239	209	213
60	214	213	215	218	244	243	252	254	223	222
70	225	223	233	234	264	265	264	265	232	232
80	251	248	260	268	312	316	280	283	250	250
90	360	369	311	319	363	364	321	328	341	346
95	378	378	325	328	378	378	349	355	369	373
EP	406	389	343	348	400	390	374	389	407	400
Rec.	98.0	94.8	99.0	98.6	98.0	97.3	97.0	97.0	98.0	97.4
Res.	1.0	1.0	1.0	1.0	1.0	1.0	1.5	1.0	1.0	1.0
Loss	1.0	4.2	0.0	0.4	1.0	1.7	1.5	2.0	1.0	1.6
RVP, psi	12.8	12.9	7.9	8.0	8.8	8.6	13.3	13.3	10.1	10.5
T _{V/L} =20	110.8		141.7		141.8		110.0		125.0	

TEST FUEL PROPERTIES BY LABORATORIES

HYDROCARBON + 9.5 VOL.% METHANOL:TBA (1:1)

FUEL NO.	<u>11</u>		<u>12</u>		<u>13</u>		<u>14</u>		<u>15</u>	
LAB. I.D.	A	B	A	B	A	B	A	B	A	B
D 86 Dist. % Evap., °F										
IBP	87	84	113	115	108	108	86	86	96	95
5	104	102	132	135	130	132	105	107	114	118
10	110	109	140	143	143	143	115	115	126	126
20	121	120	161	166	174	173	129	128	138	139
30	136	133	178	183	204	203	149	148	165	168
40	164	162	188	192	219	220	190	192	193	198
50	201	199	195	199	230	231	226	228	212	217
60	218	220	203	206	242	241	241	241	225	228
70	233	230	214	217	258	259	253	255	238	240
80	259	263	235	246	286	292	275	279	266	272
90	368	369	304	317	369	370	317	321	339	345
95	375	379	322	329	384	384	343	349	362	364
EP	408	393	363	360	407	399	378	377	382	382
Rec.	99.0	97.9	99.5	98.7	98.0	97.2	98.0	97.6	97.0	97.3
Res.	1.0	1.0	0.5	1.0	1.5	1.0	1.4	1.0	1.8	1.0
Loss	0.0	1.1	0.0	0.3	0.5	1.8	0.6	1.4	1.2	1.7
RVP, psi	12.0	12.2	8.3	8.7	9.1	9.2	12.1	12.0	10.2	10.5
T _{V/L=20}	112.0		120.8		134.2		114.2		123.0	

A P P E N D I X E

RAW DATA

GLOSSARY FOR RAW DATA

OBS = Individual Observation Number for Each Test
 FUEL = Fuel Number
 VEH = Vehicle Number

 RUN = Chronological Test Day
 RATER = Designation for Individual Rater
 SOAKT = Overnight Soak Temperature

 RUNT = Ambient Temperature at Beginning of Individual Test
 CTWD = Total Weighted Demerits for Cold-Start and Driveaway Cycle
 HTWD = Total Weighted Demerits for Warmed-Up Cycle

 TT1 through TT7
 = Fuel Tank Temperatures Taken at Seven Times During Cold-Start and Driveaway Cycle

 HES = Number of Hesitation Demerits During Cold-Start and Driveaway Cycle

 STUM = Number of Stumble Demerits During Cold-Start and Driveaway Cycle
 SURG = Number of Surge Demerits During Cold-Start and Driveaway Cycle

 BF = Number of Backfire Demerits During Cold-Start and Driveaway Cycle

 ACST = Number of Acceleration Stall Demerits During Cold-Start and Driveaway Cycle

 DCST = Number of Deceleration Stall Demerits During Cold-Start and Driveaway Cycle

 INITST = Number of Initial Starting Demerits During Cold-Start and Driveaway Cycle

 RSTRT1 through RSTRT3
 = Number of Restarting Demerits (for first three weeks) During Cold-Start and Driveaway Cycle

 IDNEUT = Number of Idle Demerits in Neutral Gear During Cold-Start and Driveaway Cycle

 STNEUT = Number of Stall Demerits While Idling in Neutral Gear During Cold-Start and Driveaway Cycle

 ID
 DRIVE = Number of Idle Demerits in Drive Gear During Cold-Start and Driveaway Cycle

 ST
 DRIVE = Number of Stall Demerits While Idling in Drive Gear During Cold-Start and Driveaway Cycle

PHASE=INTERMEDIATE TEMPERATURES

[illegible]

PHASE=INTERMEDIATE TEMPERATURES

[illegible]

PHASE=INTERMEDIATE TEMPERATURES

[illegible]

PHASE=INTERMEDIATE TEMPERATURES

[illegible]

PHASE=INTERMEDIATE TEMPERATURES

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89										

PHASE=INTERMEDIATE TEMPERATURES

PHASE=INTERMEDIATE TEMPERATURES

[illegible]

PHASE-INTERMEDIATE TEMPERATURES

[illegible]

PHASE-INTERMEDIATE TEMPERATURES

ID	FUEL	URUM	RATER	SQUART	RHIT	CWD	HWD	T1	T2	T3	T4	T5	T6	T7	HES	SUM	SURF	ACST	DCST	IWT	RSTI1	RSTI2	RSTI3	IDMEUT	STMEUT	IDDRIVE	STDRIVE	ID
385	13	21	9	R	46	84	0	47	47	48	49	50	52	54	72	12	0	0	0	0	0	0	0	0	0	0	0	0
386	13	22	15	R	32	150	30	41	41	42	43	45	47	48	84	4	0	32	0	1	0	0	0	0	0	8	17	0
387	13	23	15	R	32	384	34	41	42	43	46	49	52	55	216	48	56	32	0	2	0	0	0	0	4	26	0	0
388	13	24	15	R	32	85	28	50	51	51	52	54	56	58	30	0	20	32	0	8	0	0	0	0	1	0	0	0
389	13	25	1	R	43	139	24	0	0	0	0	0	0	0	24	18	64	32	0	0	0	0	0	0	0	5	0	0
390	13	26	1	R	43	33	39	1	0	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	1	0	0
391	13	27	1	R	43	47	36	0	47	48	48	50	50	52	36	0	0	0	0	0	0	0	0	0	0	0	0	0
392	14	1	10	R	46	42	0	49	49	51	52	54	56	58	0	0	0	0	0	0	0	0	0	0	0	0	0	0
393	14	2	10	S	46	43	84	0	45	46	47	47	50	53	48	6	24	0	0	0	0	0	0	0	0	0	0	0
394	14	3	10	T	46	54	23	3	45	0	0	0	0	50	0	12	4	0	0	0	0	0	0	2	0	4	0	0
395	14	4	11	S	52	52	28	0	51	54	56	58	60	64	65	12	16	0	0	0	0	0	0	1	0	6	0	0
396	14	5	11	T	52	57	183	24	53	53	54	56	59	61	63	12	138	0	0	0	0	0	0	0	0	0	0	0
397	14	6	11	T	35	45	39	0	43	52	44	46	48	50	52	18	18	0	0	0	0	0	0	0	0	13	0	0
398	14	7	2	T	35	51	56	80	45	47	48	51	54	57	60	12	24	8	0	1	0	0	0	1	0	2	0	0
399	14	8	2	R	35	50	24	1	43	45	46	48	51	54	56	12	0	0	0	0	0	0	0	1	0	10	0	0
400	14	9	2	R	35	46	54	33	48	48	50	52	56	59	63	30	12	4	0	0	0	0	0	0	0	8	0	0
401	14	10	10	S	46	56	120	8	47	0	0	0	0	0	72	0	24	0	0	0	0	0	0	0	2	14	0	0
402	14	11	10	R	46	44	0	49	49	50	51	52	54	56	0	0	0	0	0	0	0	0	0	0	0	0	0	0
403	14	12	10	R	52	56	16	2	53	53	53	54	55	56	58	6	0	0	0	0	0	0	0	0	0	10	0	0
404	14	13	11	T	52	57	24	0	54	55	56	58	60	64	65	24	0	0	0									

PHASE=INTERMEDIATE TEMPERATURES

[illegible]

PHASE-LOW TEMPERATURES

[illegible]

PHASE=LOW TEMPERATURES

Q B S	F U E L	V E H	R U N	R A T I O	S U M	C U M	H U M	I 1	I 2	I 3	I 4	I 5	I 6	I 7	H E S	S U M	S U R C E	S U B	A C C Y	D C C Y	I M I T Y	R S T R I 1	R S T R I 2	R S T R I 3	I D N E U T	S T H E U T	I D D R I V E	S T P R I V E
518	2	63	7	27	27	2	27	27	27	27	30	33	35	37	24	6	16	0	0	0	6	0	0	0	4	0	16	0
519	2	64	7	27	28	57	27	28	28	28	29	30	31	33	156	0	116	0	32	0	0	0	0	0	2	0	18	0
520	2	65	12	31	32	31	32	31	32	33	33	34	35	36	78	0	152	0	64	0	0	0	0	0	2	0	13	0
521	2	66	12	32	32	30	32	32	32	33	33	34	35	37	30	48	0	0	0	0	0	0	0	0	1	0	24	0
522	2	67	12	30	31	16	30	31	31	32	32	32	33	35	36	42	0	0	0	0	0	0	0	0	1	0	14	0
523	2	68	12	31	31	69	31	31	31	31	31	31	34	34	30	0	32	0	0	0	0	0	0	0	1	0	6	0
524	3	41	3	-4	-5	36	-4	-4	-4	-3	-3	-2	0	1	0	0	0	0	0	0	0	13	13	0	0	0	5	24
525	3	42	3	0	-4	222	-2	-2	-2	-1	-1	0	5	8	24	48	56	0	0	32	3	0	0	0	0	0	10	0
526	3	43	3	-8	-5	119	-3	-3	-3	4	9	13	15	15	60	0	48	0	0	0	0	0	0	0	2	0	6	0
527	3	44	8	33	33	20	33	34	36	37	39	41	41	41	0	90	96	0	0	0	1	0	0	0	1	0	12	0
528	3	44	18	20	20	56	20	22	24	26	28	30	32	34	12	0	104	0	0	0	0	0	0	2	0	10	0	0
529	3	45	8	35	35	40	35	37	38	40	42	44	44	44	30	12	8	0	0	0	0	0	0	0	2	0	13	0
530	3	45	18	20	20	60	20	21	23	25	28	30	32	33	66	6	12	0	0	0	0	0	0	0	0	0	10	0
531	3	46	8	40	40	55	40	40	40	40	40	40	40	40	48	0	0	0	0	0	0	0	0	0	0	0	16	0
532	3	46	18	18	18	100	18	18	18	18	18	18	18	18	0	42	0	0	0	0	0	0	0	2	0	5	0	0
533	3	47	13	29	29	70	29	26	28	30	32	34	34	34	108	30	108	0	0	0	0	0	0	2	0	14	0	0
534	3	48	13	23	23	235	23	26	28	29	31	33	33	33	84	0	12	0	0	0	0	0	0	2	0	17	0	0
535	3	49	13	26	26	133	26	27	28	31	32	34	34	34	84	12	12	0	0	0	0	0	0	2	0	15	0	0
536	3	50	3	-3	-3	146	-3	-3	-3	-3	-1	0	3	5	42	60	8	0	0	0	0	13	13	0	2	0	10	0
537	3	51	3	-6	-6	530	-6	-6	-6	-6	-7	-4	-2	1	0	0	0	0	864	0	0	13	13	0</				

PHASE=LOW TEMPERATURES

[illegible]

PHASE-LOW TEMPERATURES

[illegible]

PHASE=LOW TEMPERATURES

[illegible]

PHASE=LOW TEMPERATURES

[illegible]

PHASE=LOW TEMPERATURES

ID	FUEL	URN	RACTOR	SQUANT	RWMT	CYMD	HYMD	T1	T2	T3	T4	T5	T6	T7	HES	SUM	SURC	EFF	ACCT	OCCY	IMTST	IRSTRI	RSTR2	RSTR3	IDMEUT	STIMEUT	ISDRIUE	STDRIVE	FUEL	
																													0	1
750	10	47	16	31	32	188	64	35	34	35	36	37	39	40	30	6	140	0	0	0	0	0	0	0	0	0	0	0	0	
751	10	47	18	17	19	155	54	0	0	0	0	0	0	0	48	6	96	0	0	0	0	0	0	0	0	0	0	0	11	
752	10	48	16	31	42	70	28	38	34	39	39	42	42	44	18	6	0	0	0	0	0	0	0	0	0	0	0	0	18	
753	10	48	16	17	37	72	12	20	21	22	23	25	27	29	90	36	0	0	0	0	0	0	0	0	0	0	0	0	7	
754	10	48	18	17	17	119	2	38	39	40	41	44	45	49	0	42	0	0	0	0	0	0	0	0	0	0	0	0	15	
755	10	49	16	30	42	54	10	33	33	34	36	37	39	41	24	42	0	0	0	0	0	0	0	0	0	0	0	0	10	
756	10	49	18	31	32	83	16	19	19	21	23	25	27	30	18	48	0	0	0	0	0	0	0	0	0	0	0	0	14	
757	10	50	13	23	29	137	52	28	28	28	30	31	33	34	42	6	72	0	0	0	0	0	0	0	0	0	0	0	16	
758	10	50	19	23	28	80	24	20	20	20	21	23	25	27	0	6	64	0	0	0	0	0	0	0	0	0	0	0	8	
759	10	51	13	23	28	768	26	27	27	28	30	31	33	35	6	4	0	0	0	0	0	0	0	0	0	0	0	0	13	
760	10	51	19	12	23	116	18	19	20	21	22	24	26	29	24	30	12	0	0	0	0	0	0	0	0	0	0	0	14	
761	10	52	13	23	29	15	4	25	26	27	29	32	34	37	17	0	0	0	0	0	0	0	0	0	0	0	0	0	16	
762	10	52	19	12	23	771	14	15	18	21	26	30	35	39	24	0	24	0	0	0	0	0	0	0	0	0	0	0	18	
763	10	53	4	17	21	73	2	16	20	23	26	29	31	35	12	12	0	0	0	0	0	0	0	0	0	0	0	0	14	
764	10	55	4	17	21	44	6	22	23	24	25	27	29	31	12	36	0	0	0	0	0	0	0	0	0	0	0	0	6	
765	10	56	8	30	44	40	8	38	38	40	41	43	46	48	18	0	0	0	0	0	0	0	0	0	0	0	0	0	6	
766	10	56	16	17	19	89	16	33	34	35	37	38	41	42	48	12	8	0	0	0	0	0	0	0	0	0	0	0	13	
767	10	56	18	17	19	122	15	20	21	22	24	27	30	33	48	24	28	0	0	0	0	0	0	0	0	0	0	0	16	
768	10	57	16	31	32	63	38	33	33	33	33	33	34	34	12	6	16													

PHASE=LOW TEMPERATURES

0	806	11	43	7	U	R	R	S	R	C	H	1	2	3	4	5	6	7	H	S	T	U	M	S	U	R	C	S	F	A	C	C	S	I	H	I	T	S	I	R	S	T	R	I	1	2	3	I	D	H	E	U	S	T	H	E	U	I	D	D	R	I	U	E	S	T	P	R	I	V	E																																																																																																																																																																																																																																																																																																																																																																																																																																													
806	807	11	44	13	809	11	45	13	809	11	46	13	810	11	47	13	810	11	48	13	811	11	49	13	811	11	50	13	812	11	51	13	812	11	52	13	813	11	53	13	813	11	54	13	814	11	55	13	814	11	56	13	815	11	57	13	815	11	58	13	816	11	59	13	816	11	60	13	817	11	61	13	817	11	62	13	818	11	63	13	818	11	64	13	819	11	65	13	819	11	66	13	820	11	67	13	820	11	68	13	821	11	69	13	821	11	70	13	822	11	71	13	822	11	72	13	823	11	73	13	823	11	74	13	824	11	75	13	824	11	76	13	825	11	77	13	825	11	78	13	826	11	79	13	826	11	80	13	827	11	81	13	827	11	82	13	828	11	83	13	828	11	84	13	829	11	85	13	829	11	86	13	830	11	87	13	830	11	88	13	831	11	89	13	831	11	90	13	832	11	91	13	832	11	92	13	833	11	93	13	833	11	94	13	834	11	95	13	834	11	96	13	835	11	97	13	835	11	98	13	836	11	99	13	836	11	100	13	837	11	101	13	837	11	102	13	838	11	103	13	838	11	104	13	839	11	105	13	839	11	106	13	840	11	107	13	840	11	108	13	841	11	109	13	841	11	110	13	842	11	111	13	842	11	112	13	843	11	113	13	843	11	114	13	844	11	115	13	844	11	116	13	845	11	117	13	845	11	118	13	846	11	119	13	846	11	120	13	847	11	121	13	847	11	122	13	848	11	123	13	848	11	124	13	849	11	125	13	849	11	126	13	850	11	127	13	850	11	128	13	851	11	129	13	851	11	130	13	852	11	131	13	852	11	132	13	853	11	133	13	853	11	134	13	854	11	135	13	854	11	136	13	855	11	137	13	855	11	138	13	856	11	139	13	856	11	140	13	857	11	141	13	857	11	142	13	858	11	143	13	858	11	144	13	859	11	145	13	859	11	146	13	860	11	147	13	860	11	148	13	861	11	149	13	861	11	150	13	862	11	151	13	862	11	152	13	863	11	153	13	863	11	154	13	864	11	155	13	864	11	156	13	865	11	157	13	865	11	158	13	866	11	159	13	866	11	160	13	867	11	161	13	867	11	162	13	868	11	163	13	868	11	164	13	869	11	165	13	869	11	166	13	870	11	167	13	870	11	168	13

PHASE=LOW TEMPERATURES

[illegible]

PHASE=LOW TEMPERATURES

[illegible]

PHASE=LOW TEMPERATURES

[illegible]

A P P E N D I X F

WARMED-UP DRIVEABILITY PROCEDURE

AVERAGE DEMERITS

TABLE F-I

WARMED-UP DRIVEABILITY PROCEDURE AVERAGE DEMERITS(INTERMEDIATE-TEMPERATURE PHASE)

FUEL: CARB	Hydrocarbon-Only					Hydrocarbon + 10% Vol.% Ethanol					Hydrocarbon +9.5 Vol.% Methanol/TBA (1:1)					Average
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
17	24	0	10	6	6	0	20	0	0	12	11	0	1	6	8	7
19	0	8	0	4	12	0	30	6	0	15	2	0	0	1	21	7
21	2	0	0	0	4	0	0	1	0	0	8	0	0	0	2	1
22	56	20	2	44	13	8	4	4	20	18	18	14	30	15	30	20
23	20	28	4	12	47	64	52	94	18	30	30	84	34	64	32	41
24	6	0	0	16	21	0	0	0	0	0	0	1	8	12	12	5
25	0	2	8	0	2	0	3	2	3	3	6	0	24	0	7	4
26	44	12	24	10	12	26	12	8	24	23	18	0	1	0	9	15
27	13	4	0	12	12	14	33	18	0	17	0	6	0	10	9	10
AVG.	18	8	5	12	14	12	17	15	7	13	10	12	11	12	14	12
F-1																
TBI																
1	2	0	0	0	1	0	1	0	1	0	0	0	2	0	8	1
2	2	0	0	0	2	1	0	2	0	0	0	2	2	0	1	1
3	1	1	24	3	21	0	22	12	44	4	2	0	44	3	16	13
4	4	0	0	3	14	0	0	0	0	4	0	0	2	0	2	2
5	8	0	26	0	4	17	60	132	156	16	26	12	6	24	17	34
7	0	2	0	61	2	4	13	2	14	14	2	0	0	0	5	8
8	10	1	42	3	17	2	35	2	23	20	0	4	8	80	10	17
9	0	0	19	0	4	0	2	0	4	2	1	0	1	1	0	2
20	0	0	0	0	1	0	2	0	1	1	0	0	4	0	10	1
AVG.	3	0	12	8	7	3	15	17	27	7	3	2	8	12	8	9

TABLE F-I - (Continued)

WARMED-UP DRIVEABILITY PROCEDURE AVERAGE DEMERITS

(INTERMEDIATE-TEMPERATURE PHASE)

FUEL: PFI	Hydrocarbon-Only					Hydrocarbon + 10% Vol.% Ethanol					Hydrocarbon +9.5 Vol.% Methanol/TBA (1:1)					Average
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
10	0	4	0	0	1	8	0	6	1	0	8	18	0	33	12	6
11	14	2	0	14	11	0	2	4	30	2	4	0	26	8	2	8
12	0	0	2	0	4	0	0	0	1	0	0	0	2	0	14	2
13	0	0	2	0	0	0	0	3	0	0	28	1	0	2	6	3
14	0	0	0	0	0	0	0	0	0	6	1	0	0	0	0	0
15	2	2	0	3	18	0	0	3	2	10	2	44	3	46	2	9
16	4	4	2	3	15	4	0	2	0	4	0	2	2	4	2	3
18	0	1	0	66	2	4	2	3	2	15	0	0	0	0	2	6
AVG.	2	2	1	11	6	2	0	3	4	5	5	8	4	12	5	5
FLEET AVERAGE	8	4	6	10	9	6	11	12	13	8	6	7	8	12	9	9

F-2

TABLE F-II

WARMED-UP DRIVEABILITY PROCEDURE AVERAGE DEFERITS

(LOW-TEMPERATURE PHASE)

FUEL: CARB	Hydrocarbon-Only					Hydrocarbon + 10% Vol.% Ethanol					Hydrocarbon +9.5 Vol.% Methanol/TBA (1:1)					Average
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
59	1	12	19	1	19	36	58	12	52	31	1	11	147	14	56	31
60	8	0	2	14	63	41	24	62	20	3	15	71	2	28	33	26
61	66	0	0	20	14	12	2	6	7	38	43	10	2	28	14	18
63	20	2	51	2	25	57	2	0	1	3	4	62	8	80	6	22
64	2	57	11	1	18	0	58	2	9	17	46	2	8	1	26	17
65	4	31	15	4	16	33	8	28	2	4	2	4	2	0	14	11
66	30	3	10	40	18	8	22	52	16	39	16	30	4	0	2	19
67	20	16	66	22	44	50	54	22	53	48	35	14	56	2	40	36
68	4	16	2	10	32	116	15	36	2	3	2	18	0	2	0	17
AVG.	17	15	20	13	28	39	27	24	18	21	18	25	25	17	21	22
TBI																
41	2	0	1	4	46	29	2	32	2	4	4	59	3	4	17	14
42	2	2	8	0	3	3	4	2	4	44	46	2	4	36	4	11
43	2	0	22	2	3	10	51	2	17	4	4	27	66	26	68	20
44	10	4	48	3	19	43	4	2	0	4	4	36	15	56	5	17
45	4	34	5	4	19	3	56	4	4	26	32	8	4	6	17	15
46	32	2	9	41	14	2	1	0	2	2	13	8	37	2	16	12
47	44	9	4	35	20	4	4	21	12	70	10	27	2	0	2	18
48	1	4	60	14	12	4	50	10	51	20	20	10	62	2	4	22
49	3	29	14	4	19	42	2	50	2	9	2	8	4	2	2	13
AVG.	11	9	19	12	17	16	19	14	10	20	15	21	22	15	15	16

T-3

TABLE F-II - (Continued)

WARMED-UP DRIVEABILITY PROCEDURE AVERAGE DEMERITS(LOW-TEMPERATURE PHASE)

FUEL: PFI	Hydrocarbon-Only					Hydrocarbon + 10% Vol.% Ethanol					Hydrocarbon +9.5 Vol.% Methanol/TBA (1:1)					Average
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
50	0	2	2	0	28	4	4	6	10	38	56	6	4	29	4	13
51	0	41	16	6	10	55	32	14	32	22	42	17	72	40	48	30
52	2	2	2	4	44	38	3	44	2	4	4	48	4	4	6	14
53	4	28	5	4	31	4	24	3	4	14	28	2	4	2	14	11
54	29	3	6	31	6	2	2	0	0	2	26	4	32	1	16	11
55	11	2	38	2	28	16	2	0	2	6	1	37	0	73	1	15
56	2	4	39	4	14	4	28	4	59	13	42	10	26	2	4	17
57	8	42	8	8	75	264	10	208	6	59	2	8	4	4	20	48
58	21	2	4	32	6	2	4	10	10	36	4	0	4	24	2	11
AVG.	8	14	13	10	27	43	12	32	14	22	23	15	17	20	13	19
FLEET AVERAGE	12	13	17	12	24	33	19	23	14	21	19	20	21	17	16	19

A P P E N D I X 6

**CLASSIFICATION OF TOTAL WEIGHTED DEMERITS
BY MALFUNCTION**

TABLE G-1
MALFUNCTION-TYPE TOTAL WEIGHTED DEMERITS
INTERMEDIATE-TEMPERATURE PHASE

	<u>Start</u> <u>Dem.</u>	<u>Idle</u> <u>Neu.</u> <u>Dem.</u>	<u>Idle</u> <u>Drive</u> <u>Dem.</u>	<u>Hesi-</u> <u>tation</u>	<u>Stumble</u>	<u>Surge</u>	<u>Back-</u> <u>fire</u>	<u>Acc.</u> <u>Stall</u>	<u>Dec.</u> <u>Stall</u>	<u>Total</u>
<u>HYDROCARBON</u> <u>-ONLY FUELS</u>										
CARB	14	95	344	1686	810	952	0	96	0	3997
TBI	2	59	313	324	114	176	0	0	0	988
PFI	4	28	323	708	408	268	0	32	0	1771
FLEET	20	182	980	2718	1332	1396	0	128	0	6756
<u>GASOLINE-</u> <u>ETHANOL</u> <u>BLENDS</u>										
CARB	24	74	377	2028	936	732	24	96	32	4283
TBI	0	40	300	1368	726	328	0	224	32	3018
PFI	4	122	399	564	192	316	0	0	0	1597
FLEET	28	236	1036	3960	1854	1376	24	320	64	8898
<u>GASOLINE-</u> <u>METHANOL:TBA</u> <u>(1:1)</u> <u>BLENDS</u>										
CARB	36	122	359	2478	1002	1188	0	320	0	5500
TBI	7	36	319	1488	666	428	0	96	32	3072
PFI	29	98	393	882	330	220	6	64	0	2022
FLEET	72	256	1071	4848	1998	1836	6	480	32	10599

TABLE G-II
MALFUNCTION-TYPE PERCENTAGE
INTERMEDIATE-TEMPERATURE PHASE

	<u>Start</u> <u>Dem.</u>	<u>Idle</u> <u>Neu.</u> <u>Dem.</u>	<u>Idle</u> <u>Drive</u> <u>Dem.</u>	<u>Hesi-</u> <u>tation</u>	<u>Stumble</u>	<u>Surge</u>	<u>Back-</u> <u>fire</u>	<u>Acc.</u> <u>Stall</u>	<u>Dec.</u> <u>Stall</u>	<u>Total</u>
<u>HYDROCARBON</u> <u>-ONLY FUELS</u>										
CARB	0.4	2.4	8.6	42.1	20.3	23.8	0.0	2.4	0.0	100.0
TBI	0.2	6.0	31.7	32.8	11.5	17.8	0.0	0.0	0.0	100.0
PFI	0.2	1.6	18.2	40.1	23.0	15.1	0.0	1.8	0.0	100.0
FLEET	0.3	2.7	14.5	40.2	19.7	20.7	0.0	1.9	0.0	100.0
<u>GASOLINE-</u> <u>ETHANOL</u> <u>BLENDS</u>										
CARB	0.6	1.7	7.9	47.3	21.8	17.1	0.6	2.2	0.8	100.0
TBI	0.0	1.3	9.9	45.3	24.1	10.9	0.0	7.4	1.1	100.0
PFI	0.2	7.6	25.0	35.4	12.0	19.8	0.0	0.0	0.0	100.0
FLEET	0.3	2.6	11.6	44.6	20.8	15.5	0.3	3.6	0.7	100.0
<u>GASOLINE-</u> <u>METHANOL:TBA</u> <u>(1:1)</u> <u>BLENDS</u>										
CARB	0.6	2.2	6.5	45.1	18.2	21.6	0.0	5.8	0.0	100.0
TBI	0.2	1.2	10.4	48.5	21.7	13.9	0.0	3.1	1.0	100.0
PFI	1.4	4.8	19.4	43.7	16.3	10.9	0.3	3.2	0.0	100.0
FLEET	0.7	2.4	10.1	45.8	18.8	17.3	0.1	4.5	0.3	100.0

TABLE G-III
MALFUNCTION-TYPE TOTAL WEIGHTED DEMERITS
LOW-TEMPERATURE PHASE

	<u>Start</u> <u>Dem.</u>	<u>Idle</u> <u>Neu.</u> <u>Dem.</u>	<u>Idle</u> <u>Drive</u> <u>Dem.</u>	<u>Hesi-</u> <u>tation</u>	<u>Stumble</u>	<u>Surge</u>	<u>Back-</u> <u>fire</u>	<u>Acc.</u> <u>Stall</u>	<u>Dec.</u> <u>Stall</u>	<u>Total</u>
<u>HYDROCARBON</u> <u>-ONLY FUELS</u>										
CARB	73	133	641	2982	1314	2380	24	512	32	8091
TBI	71	98	648	1824	1134	1796	0	0	32	5603
PFI	142	149	898	1284	546	1572	0	896	0	5487
FLEET	286	380	2187	6090	2994	5748	24	1408	64	19181
<u>GASOLINE-</u> <u>ETHANOL</u> <u>BLENDS</u>										
CARB	124	98	793	3168	1596	2492	0	1792	0	10063
TBI	101	106	664	1878	690	1616	0	224	0	5279
PFI	188	152	1016	1260	630	1588	6	1856	64	6760
FLEET	413	356	2473	6306	2916	5696	6	3872	64	22102
<u>GASOLINE-</u> <u>METHANOL:TBA</u> <u>(1:1)</u> <u>BLENDS</u>										
CARB	148	117	564	3000	1698	1868	24	1088	32	8539
TBI	174	157	720	2346	846	1772	0	352	0	6367
PFI	253	123	829	1614	492	1436	6	160	0	4913
FLEET	575	397	2113	6960	3036	5076	30	1600	32	19819

TABLE G-IV
MALFUNCTION-TYPE PERCENTAGE
LOW-TEMPERATURE PHASE

	<u>Start</u> <u>Dem.</u>	<u>Idle</u> <u>Neu.</u> <u>Dem.</u>	<u>Idle</u> <u>Drive</u> <u>Dem.</u>	<u>Hesi-</u> <u>tation</u>	<u>Stumble</u>	<u>Surge</u>	<u>Back-</u> <u>fire</u>	<u>Acc.</u> <u>Stall</u>	<u>Dec.</u> <u>Stall</u>	<u>Total</u>
<u>HYDROCARBON</u> <u>-ONLY FUELS</u>										
CARB	0.9	1.6	7.9	36.9	16.2	29.5	0.3	6.3	0.4	100.0
TBI	1.3	1.7	11.6	32.5	20.2	32.1	0.0	0.0	0.6	100.0
PFI	2.6	2.7	16.4	23.4	9.9	28.7	0.0	16.3	0.0	100.0
FLEET	1.5	2.0	11.4	31.8	15.6	30.0	0.1	7.3	0.3	100.0
<u>GASOLINE-</u> <u>ETHANOL</u> <u>BLENDS</u>										
CARB	1.2	1.0	7.9	31.4	15.9	24.8	0.0	17.8	0.0	100.0
TBI	1.9	2.0	12.6	35.6	13.1	30.6	0.0	4.2	0.0	100.0
PFI	2.8	2.2	15.0	18.6	9.3	23.5	0.1	27.5	1.0	100.0
FLEET	1.9	1.6	11.2	28.5	13.2	25.8	0.0	17.5	0.3	100.0
<u>GASOLINE-</u> <u>METHANOL: TBA</u> <u>(1:1)</u> <u>BLENDS</u>										
CARB	1.7	1.4	6.6	35.1	19.9	21.9	0.3	12.7	0.4	100.0
TBI	2.7	2.5	11.3	36.9	13.3	27.8	0.0	5.5	0.0	100.0
PFI	5.0	2.5	16.9	32.9	10.0	29.3	0.1	3.3	0.0	100.0
FLEET	2.9	2.0	10.7	35.0	15.3	25.6	0.2	8.1	0.2	100.0

A P P E N D I X H

FUEL TANK TEMPERATURES

APPENDIX HFuel Tank Temperatures

Fuel tank temperatures were recorded during the seven 30-second idle segments of each cold-start and warmup driveability evaluation: start of test, 0.5, 1.0, 1.5, 2.2, 2.9, and 3.6 miles. The data analysis was performed on the basis of the difference between each observed temperature and the 0.5-mile reading. The 0.5-mile temperature was used as the base since it was more reliable than the initial tank temperature.

Models for predicting the increase in tank temperature with miles travelled were determined by regression. The model which provides the best combination of simplicity and accuracy (R-square value of 0.81) uses the square root of delta tank temperature as the dependent variable with run temperature, distance travelled, distance travelled squared, and fuel system type as the independent variables. Results of the analysis of variance and parameter estimates are shown in Table H-1. All variables were determined to be significant.

The model is:

$$T = (-1.009 + 0.002*R + 1.807*D - 0.222*D^{**2} + 0.255*TBI + 0.217*PFI)^{**2}$$

where: T = fuel tank temperature rise
 R = run temperature
 D = distance travelled
 TBI = 1 if fuel system is TBI, otherwise 0
 PFI = 1 if fuel system is PFI, otherwise 0

The above model was used to calculate predicted tank temperature increases at run temperatures of 50°F and 25°F, roughly equal to the averages from the two program phases. At a distance travelled of 2.5 miles, the predicted values are:

	<u>50°F</u>	<u>25°F</u>
Carbureted	4.9	4.7
TBI	6.1	5.9
PFI	5.9	5.7

Note that the carbureted vehicles at both 50°F and 25°F show a somewhat lower tank temperature rise than the fuel-injected vehicles.

The model is depicted graphically for the intermediate- and low-temperature phases in Figures H-1 and H-2, respectively. Each figure consists of separate plots for the three fuel-system types. In constructing the tank temperature increase profile from the prediction model, a run temperature of 50°F was assumed for the intermediate-temperature phase, and 25°F for the low-temperature phase. In addition, data points for that program phase and fuel-system type have been included to give an indication of the scatter in the data.

These models are applicable for predicting fuel tank temperature rises for trips of 3.6 miles or less and at ambient temperatures of 0°F to 60°F. The models should not be used for predicting temperature rises for trips or ambient temperatures outside those ranges.

TABLE H-I

ANALYSIS OF VARIANCE -- FUEL TANK TEMPERATURE RISE

<u>SOURCE</u>	<u>DF</u>	<u>SUM OF SQUARE</u>	<u>MEAN SQUARE</u>	<u>F VALUE</u>	<u>PROB >F</u>
MODEL	5	5270.32128	1054.06426	4441.254	0.0001
ERROR	5336	1266.41858	0.23733482		
C TOTAL	5341	6536.73986			
ROOT MSE 0.4871702 R-SQUARE 0.8063					
DEP MEAN 1.656153 ADJ R-SQ 0.8061					
C.V. 29.41578					

<u>VARIABLE</u>	<u>DF</u>	<u>PARAMETER ESTIMATE</u>	<u>STANDARD ERROR</u>	<u>T FOR HO: PARAMETERS</u>	<u>PROB >T</u>	<u>VARIANCE INFLATION</u>
INTERCEP	1	-1.00936796	0.3140176	- 3.214	0.0001	0
RUNTEMP	1	0.002395054	0.000437745	5.471	0.0001	1.00080669
Distance	1	1.80699016	0.02967106	60.901	0.0001	22.80460519
Distance Squared	1	-0.22170423	0.007079927	-31.314	0.0001	22.80460823
TBI	1	0.25462773	0.01618324	15.734	0.0001	1.31082619
PFI	1	0.21668877	0.01634878	13.254	0.0001	1.31174785

H-3

NOTE: Statistical analysis using SAS (Statistical Analysis System) was performed using square root; therefore, the numbers shown in this table must be squared to obtain the correct terms.

FIGURE H-1

1986/87 CRC VOLATILITY PROGRAM
CARBURETED CARS RUN AT 50 °F

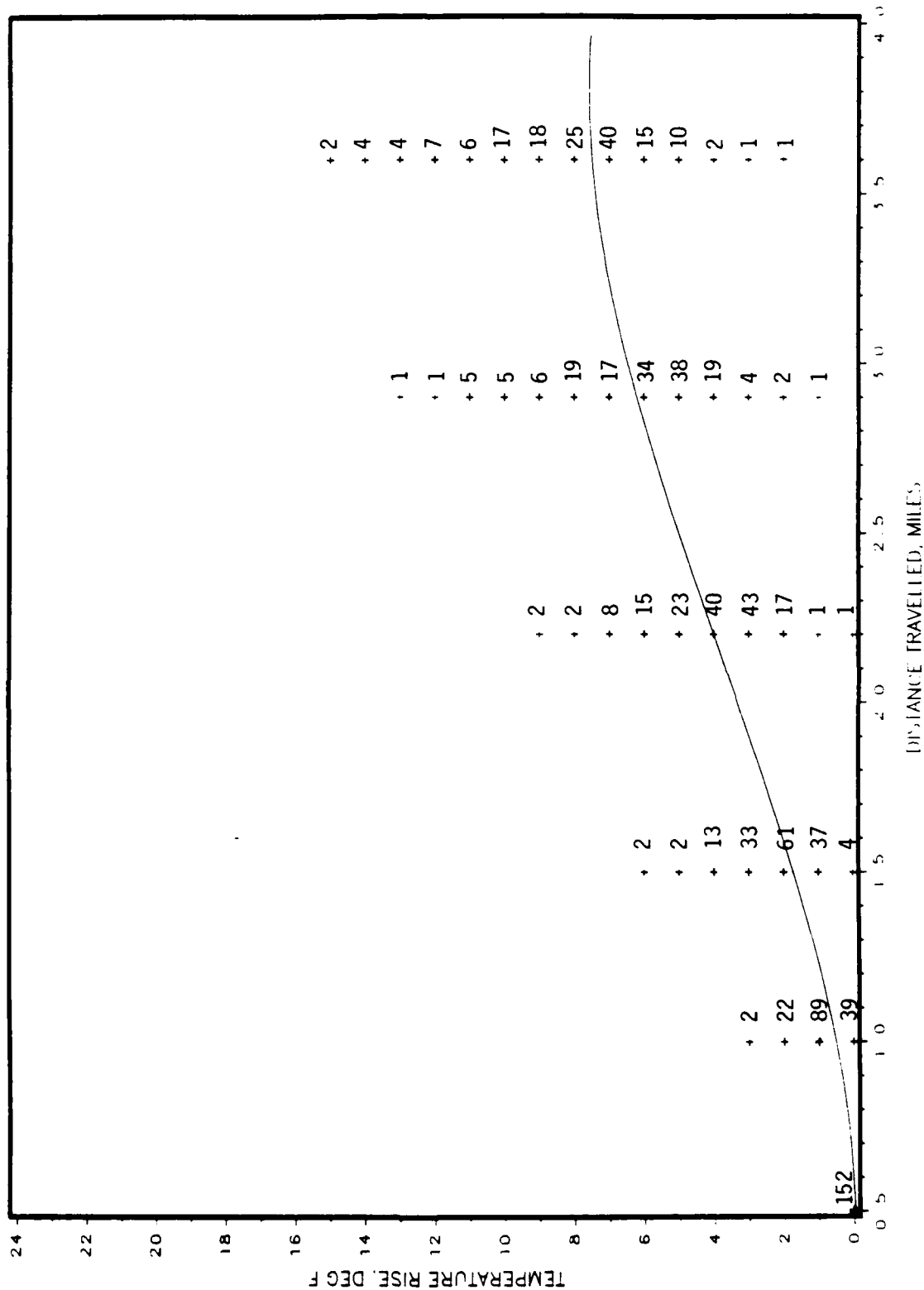
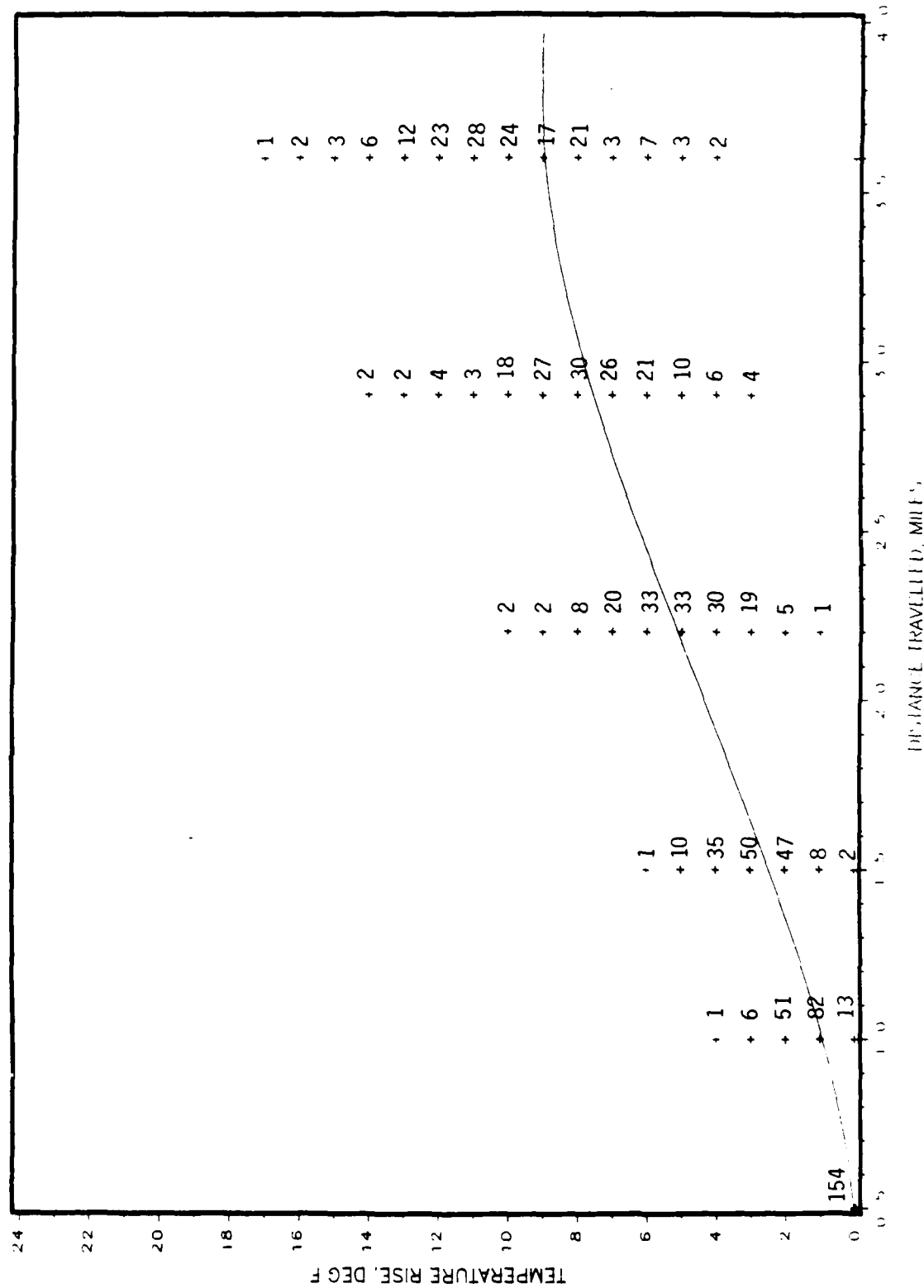


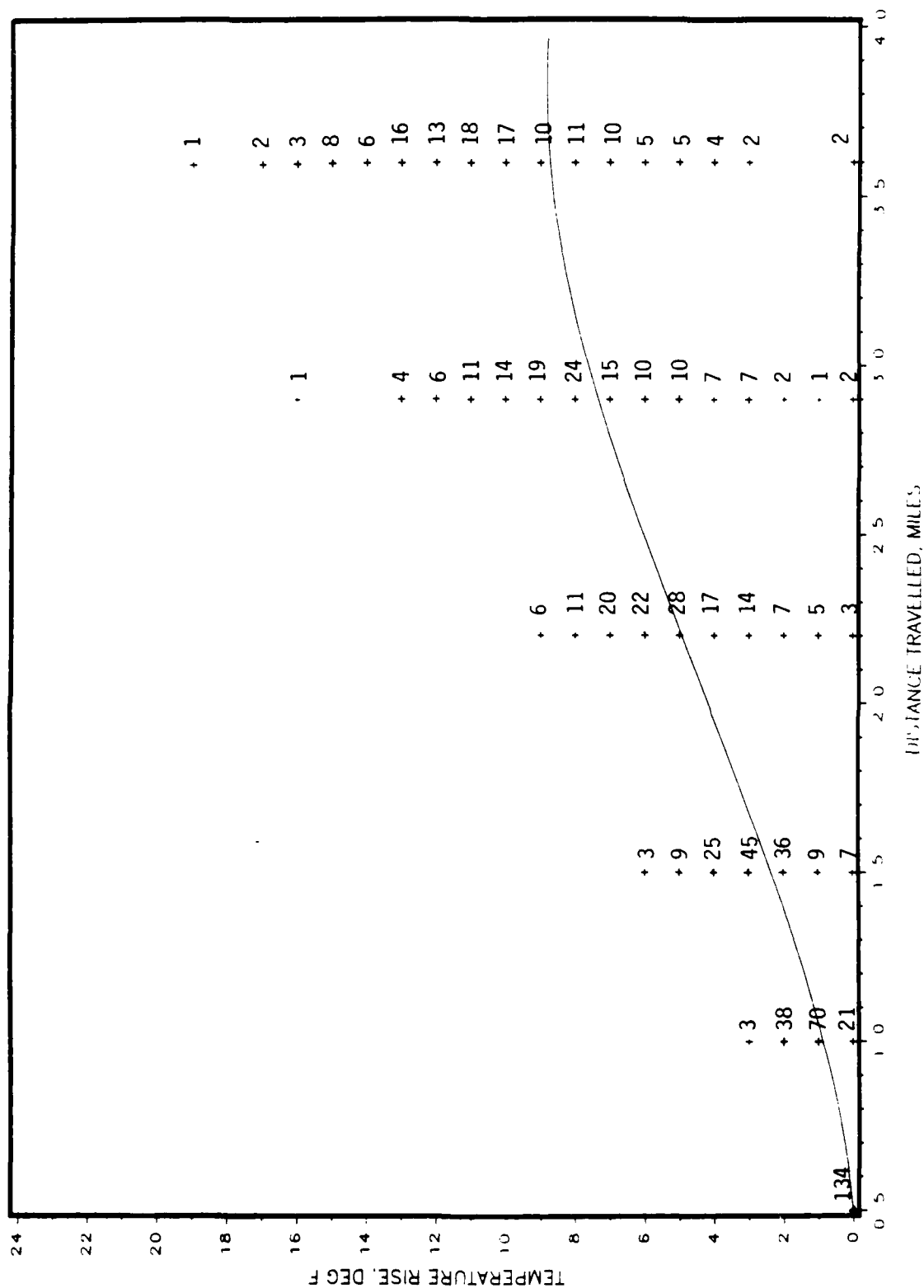
FIGURE H-1
(Continued)

1986/87 CRC VOLATILITY PROGRAM
TBI CARS RUN AT 50 °F



NOTE: Data points not shown include 5 AT's < 0° F.

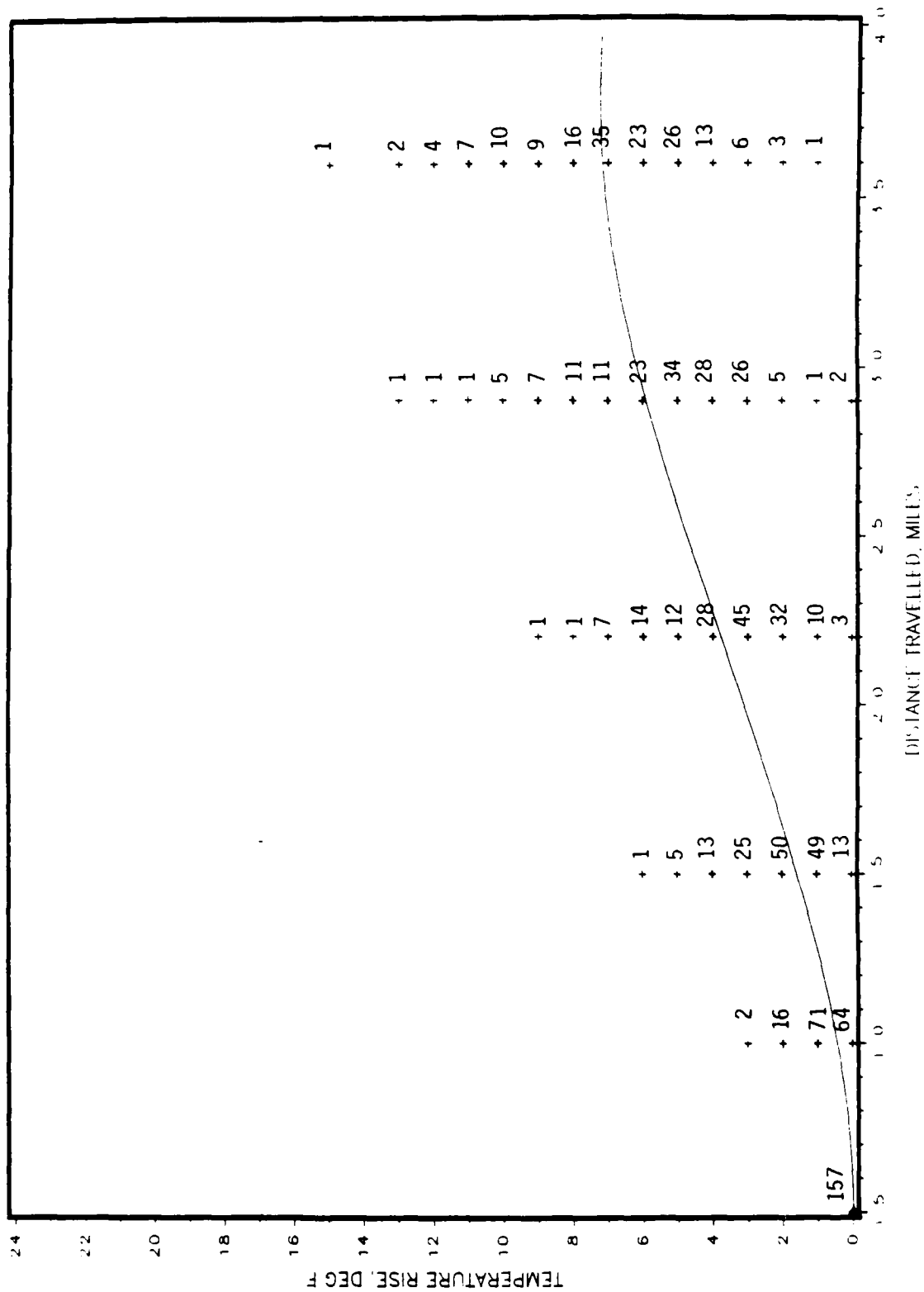
FIGURE H-1
(Continued)
1986/87 CRC VOLATILITY PROGRAM
PFI CARS RUN AT 50 °F



NOTE: Data points not shown include 1 A, T < 0 °F and 3 A, T's > 45 °F.

FIGURE H-2

1986/87 CRC VOLATILITY PROGRAM
CARBURETED CARS RUN AT 25 °F



NOTE: Data points not shown include 11 A.T.'s < 0°F.

FIGURE H-2
(Continued)

1986/87 CRC VOLATILITY PROGRAM
TBI CARS RUN AT 25°F

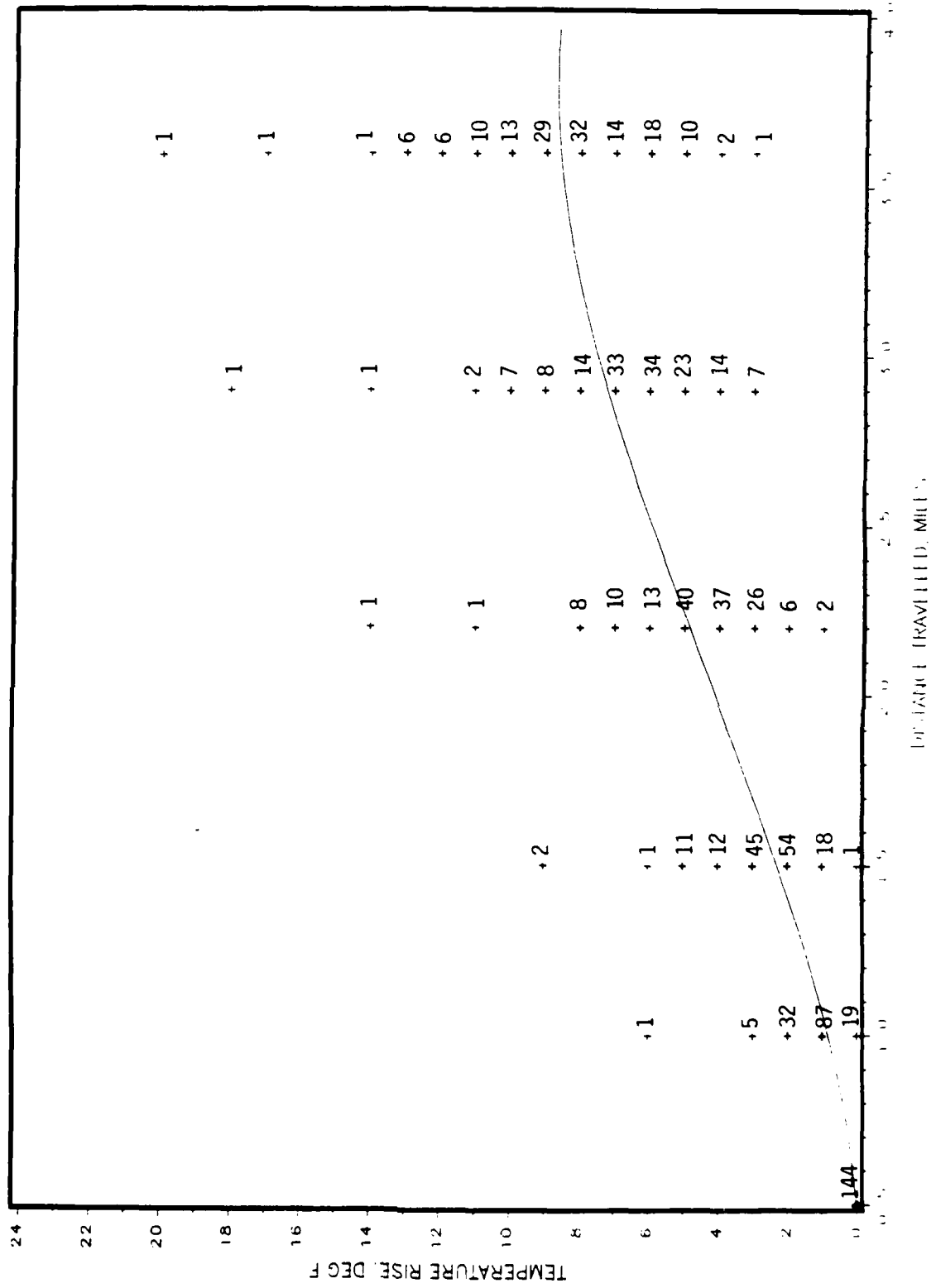
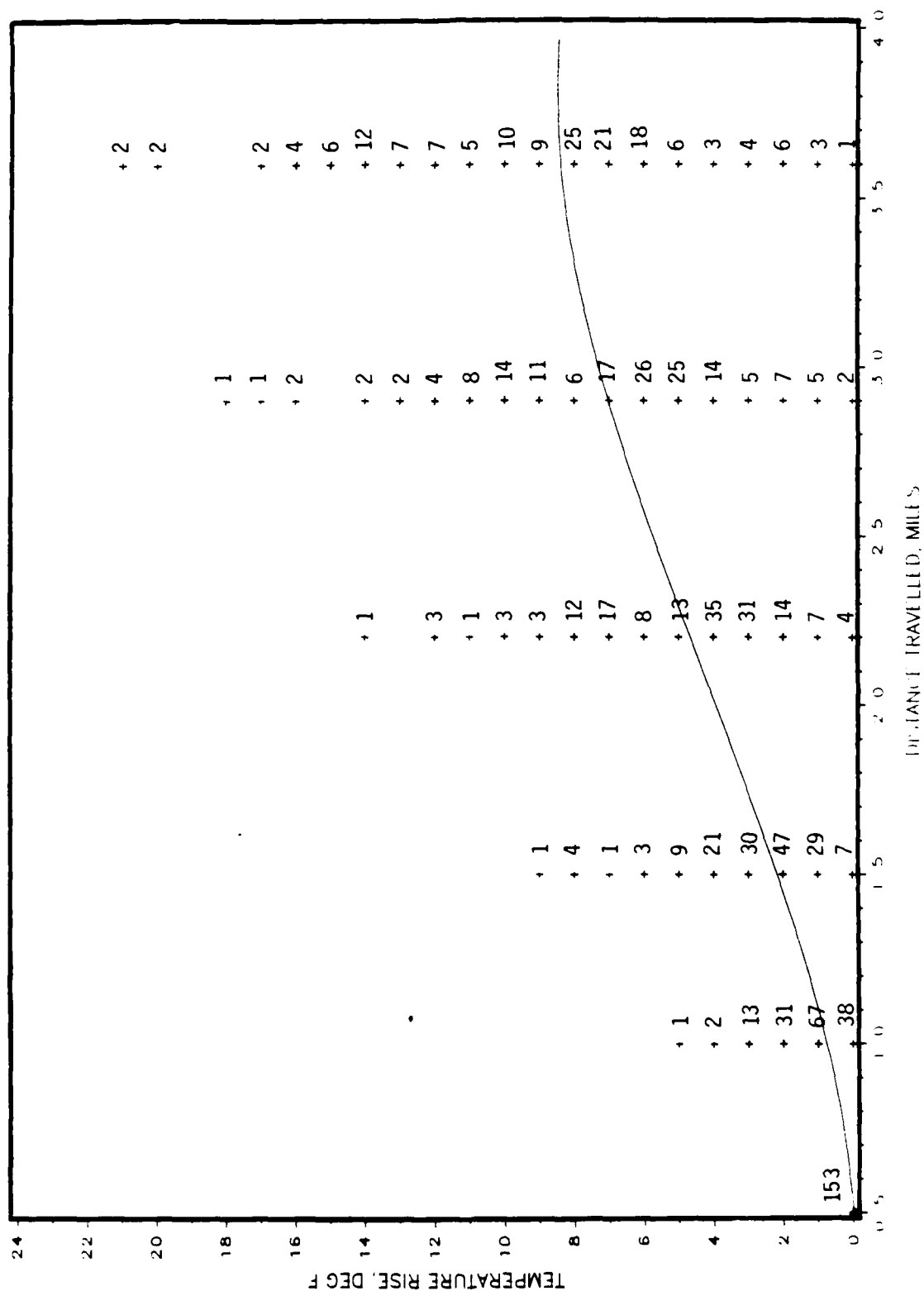


FIGURE H-2
(Continued)

1986/87 CRC VOLATILITY PROGRAM
PFI CARS RUN AT 25°F



NOTE: Data points not shown in Table 4 (Page 104).

A P P E N D I X I

SAS PROGRAM, CODE, AND OUTPUT

APPENDIX I

The models shown on page 8 in the report were derived from a SAS program using the General Linear Models Procedure (GLM). The SAS program, titled CRC8687 SAS, and the program output titled CRC8687 LISTING appear in this Appendix. The SAS program creates two models, one for the Intermediate-Temperature Phase and the other for the Low-Temperature Phase. The variables, fuel type, fuel system, vehicle, rater, T_{10} , T_{50} , T_{90} , and run temperature, were all significant at greater than 95 percent confidence level. In addition, the model shows good performance throughout the range of the experiment. An examination of the residuals (in square root) suggests normally distributed errors which validate the significance levels shown in the program output.

The coefficients of the model were computed with two BASIC programs according to the methods and references outlined in the Least Squares Means Section of the GLM chapter in "SAS Users Guide: Statistics," Ver. 5. (page 483-484). The programs are called CRC86 BASIC and CRC87 BASIC. The source code for those two programs and the output from the programs, which is called CRC8687 INTERSPT, also appear in this Appendix. Another SAS program called CRCOFFCR SAS was used to create the SAS data base from the original data file as received from CRC. This program assigned the program variables such as vehicle type, fuel type, and fuel distillation temperatures.

In addition to the model, a BASIC program has been written that will calculate the estimated TWD's for the user. The program can be used on most personal computers. The user keys in the distillation temperatures for T_{10} , T_{50} , and T_{90} , and the computer calculates the TWD's for the different fuel types and fuel systems. It also computes TWD's for a mixed fleet of vehicles along with the high and low precision limits at various confidence levels. The source code for this program is called TWDALC BASIC, and it appears in this Appendix.

```
options ls=131 gen=0;
data one;
  set sasdata.crc86;
  if veh eq 19 and run eq 18 and fuel eq 5 then delete;
  if veh eq 5 and run eq 3 and fuel eq 9 then delete;
  if veh eq 13 and run eq 20 and fuel eq 10 then delete;

proc glm data=one;
  title 'CRC 1986 Intermediate Temperature Driveability Test';
  title2 'Official Data Set';
  * title3 'All CTWD Data';
  title3 'Three runs with high residuals were deleted';
  class veh sys fueltype rater;
  model sqrttwd=fueltype sys fueltype*sys veh(sys)
    rater t10 t50 t90 runtemp fueltype*runtemp
    / ss3 solution;

  contrast 'ratio' t10 -2 t50 1,
    t90 -3 t50 1;
  test h=sys e=veh(sys);
  random veh(sys) rater;
  lsmeans sys/pdiff stderr e=veh(sys);
  lsmeans fueltype/pdiff stderr;
  lsmeans fueltype*sys/e pdiff stderr;
  output out=residual.crc86 p=p r=r;

proc univariate data=residual.crc86 normal plot;
  var r;

proc plot data=residual.crc86;
  plot r*p r*sys r*runtemp r*rater r*veh r*run r*fuel r*fueltype
    /vref=0;
  plot p*sqrttwd;

data two;
  set sasdata.crc86;
  if ((veh eq 19 and run eq 18 and fuel eq 5) or
    (veh eq 5 and run eq 3 and fuel eq 9) or
    (veh eq 13 and run eq 20 and fuel eq 10));

proc print data=two;
  title 'The following runs were deleted from this model';
  title2;
  title3;

options ls=131 gen=0;
data one;
  set sasdata.crc87;
  if ctwd ge 530 then delete;

proc glm data=one;
  title 'CRC 1987 Low Temperature Driveability Test';
  title2 'Official Data Set';
  title3 'All four runs with No-Starts are deleted';
```

```
* title3 'All CTWD Data';
class veh sys fueltype rater;
model sqrttwd=fueltype sys fueltype*sys veh(sys)
      rater t10 t50 t90 runtemp fueltype*runtemp
      / ss3 solution;

contrast 'ratio' t10 -2 t50 1,
              t90 -3 t50 1;
test h=sys e=veh(sys);
random veh(sys) rater;
lsmeans sys/pdiff stderr e=veh(sys);
lsmeans fueltype/pdiff stderr;
lsmeans fueltype*sys/e pdiff stderr;
output out=residual.crc87 p=p r=r;

proc univariate data=residual.crc87 normal plot;
var r;

proc plot data=residual.crc87;
plot r*p r*sys r*runtemp r*rater r*veh r*run r*fuel r*fueltype
      /vref=0;
plot p*sqrttwd;

data two;
set sasdata.crc87;
if (ctwd ge 530);

proc print data=two;
title 'The following runs were deleted from this model';
title2;
title3;
```

CRC 1986 Intermediate Temperature Drivability Test
 Official Data Set
 Three runs with high residuals were deleted

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS	LEVELS	VALUES
VEH	26	1 2 3 4 5 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
SYS	3	carb PFI TBI
FUELTYPE	3	EtOH HC MeOH
RATER	3	R S T

NUMBER OF OBSERVATIONS IN DATA SET = 466

CRC 1986 Intermediate Temperature Driveability Test
 Official Data Set
 Three runs with high residuals were deleted

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: SORTTWO

SOURCE	TYPE III	EXPECTED MEAN SQUARE
FUELTYPE	VAR(ERROR) + Q(FUELTYPE, SYS*FUELTYPE)	
SYS	VAR(ERROR) + 17.810047 VAR(VEH(SYS)) + Q(SYS, SYS*FUELTYPE)	
SYS*FUELTYPE	VAR(ERROR) + Q(SYS*FUELTYPE)	
VEH(SYS)	VAR(ERROR) + 17.5065758 VAR(VEH(SYS))	
RATER	VAR(ERROR) + 152.096425 VAR(RATER)	
T10	VAR(ERROR) + Q(T10)	
T50	VAR(ERROR) + Q(T50)	
T90	VAR(ERROR) + Q(T90)	
RUNTEMP	VAR(ERROR) + Q(RUNTEMP, RUNTEMP*FUELTYPE)	
RUNTEMP*FUELTYPE	VAR(ERROR) + Q(RUNTEMP*FUELTYPE)	
CONTRAST	EXPECTED MEAN SQUARE	
Ratio	VAR(ERROR) + Q(T10, T50, T90)	

CRC 1986 Intermediate Temperature Driveability Test
Official Data Set
Three runs with high residuals were deleted

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: SORTTWD						
SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE
MODEL	39	4792.34365051	122.88060642	23.03	1E-70	0.678303
ERROR	426	2272.84962450	5.33532776		ROOT MSE	
CORRECTED TOTAL	465	7065.19327501			2.30983284	
						SORTTWD MEAN
						37.0350
						6.23688439

SOURCE	DF	TYPE III SS	F VALUE	PR > F
JELTYPE	2	88.31008293	8.28	0.0003
YS	2	1062.13040382	99.54	34E-37
YS*FUELTYPE	4	7.76513224	0.36	0.8343
EH(SYS)	23	2328.32575388	18.97	15E-52
ATER	2	735.71684771	68.95	11E-27
10	1	122.44669253	22.95	230E-8
50	1	139.40895813	26.13	483E-9
30	1	33.72956013	6.32	0.0123
INTEMP	1	30.64565322	5.74	0.0170
INTEMP*FUELTYPE	2	59.01767587	5.53	0.0043

CONTRAST	DF	SS	F VALUE	PR > F
atio	2	24.06498524	2.26	0.1061

ESTS OF HYPOTHESES USING THE TYPE III MS FOR VEH(SYS) AS AN ERROR TERM

SOURCE	DF	TYPE III SS	F VALUE	PR > F
YS	2	1062.13040382	5.25	0.0113

PARAMETER	ESTIMATE	T FOR H0: PARAMETER=0	PR > T	STD ERROR OF ESTIMATE
INTERCEPT	-12.80119362 B	-3.55	0.0004	3.60708758
JELTYPE	-4.58358806 B	-1.93	0.0544	2.37611032
	-10.14832284 B	-4.03	668E-7	2.51993914
YS	0.00000000 B	5.07	593E-9	0.89345627
	4.53022791 B	-0.48	0.6327	0.90075077
	-0.43084509 B	-0.71	0.4789	0.65156831
	0.00000000 B	-0.25	0.8022	0.65121038
YS*FUELTYPE	-0.16324321 B	0.01	0.9940	0.65119239
	0.00000000 B	0.69	0.4907	0.64811183
	0.44702408 B			
	0.00000000 B			

CRC 1986 Intermediate Temperature Drivability Test
Official Data Set
Three runs with high residuals were deleted

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: SORTTWO

PARAMETER	ESTIMATE	T FOR H0: PARAMETER=0	PR > T	STD ERROR OF ESTIMATE
VEH(SYS)				
TBI EtOH	0.00000000 B			
TBI HC	0.00000000 B			
TBI MeOH	0.00000000 B			
1 carb	-4.17813110 B	-4.94	112E-8	0.84562879
19 carb	0.48029096 B	0.57	0.5683	0.84119044
21 carb	-1.02235567 B	-1.27	0.2032	0.80227168
22 carb	2.46222378 B	3.10	0.0021	0.79499210
23 carb	6.35635979 B	7.99	13E-15	0.79565395
24 carb	-2.50500224 B	-3.21	0.0014	0.78039663
25 carb	-0.87831990 B	-1.13	0.2589	0.77698153
26 carb	-0.30790613 B	-0.40	0.6898	0.77097639
27 carb	0.00000000 B			
10 PFI	1.78973058 B	2.10	0.0363	0.85228599
11 PFI	5.12824304 B	6.26	96E-11	0.81968295
12 PFI	1.77271405 B	2.17	0.0304	0.81598298
13 PFI	-0.63725267 B	-0.80	0.4248	0.79765581
14 PFI	-0.46010370 B	-0.58	0.5646	0.79820742
15 PFI	0.60875105 B	0.77	0.4397	0.78716523
16 PFI	0.52087780 B	0.67	0.5039	0.77869775
17 PFI	0.46507412 B	0.60	0.5498	0.77709013
18 PFI	0.00000000 B			
2 TBI	2.45179805 B	3.18	0.0016	0.77012767
3 TBI	2.50768209 B	3.37	0.0008	0.77040730
4 TBI	-0.13836322 B	-0.18	0.8577	0.77117039
5 TBI	6.01815554 B	7.65	14E-14	0.78677092
7 TBI	0.49850315 B	0.63	0.5261	0.78571671
8 TBI	4.49271721 B	5.63	32E-9	0.79754509
9 TBI	2.53760801 B	3.14	0.0018	0.80754005
20 TBI	0.00000000 B			
R	-3.07542202 B	-11.67	18E-28	0.26362003
S	-1.24789338 B	-4.69	377E-8	0.26633835
T	0.00000000 B			
T10	0.04304272	4.79	230E-8	0.00898477
T50	0.04546058	5.11	483E-9	0.00889345
T90	0.01366806	2.51	0.0123	0.00543603
RUNTEMP	-0.01993824 B	-0.53	0.5970	0.03768437
RUNTEMP*FUELTYPE	0.00009633 B	1.67	0.0954	0.04793227
EtOH	0.16728564 B	3.32	0.0010	0.05040818
HC	0.00000000 B			
MeOH	0.00000000 B			

NOTE: THE X'X MATRIX HAS BEEN DEEMED SINGULAR AND A GENERALIZED INVERSE HAS BEEN EMPLOYED TO SOLVE THE NORMAL EQUATIONS. THE ABOVE ESTIMATES REPRESENT ONLY ONE OF MANY POSSIBLE SOLUTIONS TO THE NORMAL EQUATIONS. ESTIMATES FOLLOWED BY THE LETTER B ARE BIASED AND DO NOT ESTIMATE THE PARAMETER BUT ARE BLUE FOR SOME LINEAR COMBINATION OF PARAMETERS (OR ARE ZERO). THE EXPECTED VALUE OF THE BIASED ESTIMATORS MAY BE OBTAINED FROM THE GENERAL FORM OF ESTIMABLE FUNCTIONS. FOR THE BIASED ESTIMATORS, THE STD ERR IS THAT OF THE BIASED ESTIMATOR AND THE T VALUE TESTS H0: E(BIASED ESTIMATOR) = 0. ESTIMATES NOT FOLLOWED BY THE LETTER B ARE BLUE FOR THE PARAMETER.

CRC 1986 Intermediate Temperature Driveability Test
Official Data Set
Three runs with high residuals were deleted

GENERAL LINEAR MODELS PROCEDURE

LEAST SQUARES MEANS
STANDARD ERRORS AND PROBABILITIES CALCULATED USING THE TYPE III MS FOR VEH(SYS) AS AN ERROR TERM

SYS	SQRTTWO LSMEAN	STD ERR LSMEAN	PROB > T H0:LSMEAN=0	PROB > T I/J	H0:LSMEAN(1)=LSMEAN(J) 2 3
carb	8.11861490	0.79601822	53E-11	1	0.0037 0.0896
PFI	4.49228884	0.79339749	917E-8	2	0.0037 0.1887
TBI	6.05886152	0.84454835	264E-9	3	0.0896 0.1887

NOTE: TO ENSURE OVERALL PROTECTION LEVEL, ONLY PROBABILITIES ASSOCIATED WITH PRE-PLANNED COMPARISONS SHOULD BE USED.

FUELTYPE	SQRTTWO LSMEAN	STD ERR LSMEAN	PROB > T H0:LSMEAN=0	PROB > T I/J	H0:LSMEAN(1)=LSMEAN(J) 2 3
EtOH	6.30256229	0.18767832	0	1	529E-7 0.0013
HC	5.21359323	0.18809511	0	2	529E-7 10E-13
MeOH	7.15360973	0.18528146	0	3	0.0013 10E-13

NOTE: TO ENSURE OVERALL PROTECTION LEVEL, ONLY PROBABILITIES ASSOCIATED WITH PRE-PLANNED COMPARISONS SHOULD BE USED.

CRC 1986 Intermediate Temperature Drivability Test
Official Data Set
Three runs with high residuals were deleted

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: SORTTWD

ESTIMABLE FUNCTIONS FOR SYS=FUELTYPE LEAST SQUARES MEANS

SYS FUELTYPE	carb EtOH	carb HC	carb MeOH	PFI EtOH	PFI HC	PFI MeOH	TBI EtOH	TBI HC	TBI MeOH
EFFECT INTERCEPT	1	1	1	1	1	1	1	1	1
FUELTYPE	1	0	0	1	0	0	1	0	
	0	1	0	0	1	0	0	1	
	0	0	1	0	0	1	0	0	1
SYS	1	1	1	0	0	0	0	0	0
	0	0	0	1	1	1	0	0	0
	0	0	0	0	0	0	1	1	1
SYS=FUELTYPE	1	0	0	0	0	0	0	0	0
	0	1	0	0	0	0	0	0	0
	0	0	1	0	0	0	0	0	0
	0	0	0	1	0	0	0	0	0
	0	0	0	0	1	0	0	0	0
	0	0	0	0	0	1	0	0	0
	0	0	0	0	0	0	1	0	0
	0	0	0	0	0	0	0	1	0
	0	0	0	0	0	0	0	0	1
VEH(SYS)	0.111111	0.111111	0.111111	0.111111	0.111111	0.111111	0.125	0.125	0.125
1 carb	0.111111	0.111111	0.111111	0.111111	0.111111	0.111111	0.125	0.125	0.125
19 carb	0.111111	0.111111	0.111111	0.111111	0.111111	0.111111	0.125	0.125	0.125
21 carb	0.111111	0.111111	0.111111	0.111111	0.111111	0.111111	0.125	0.125	0.125
22 carb	0.111111	0.111111	0.111111	0.111111	0.111111	0.111111	0.125	0.125	0.125
23 carb	0.111111	0.111111	0.111111	0.111111	0.111111	0.111111	0.125	0.125	0.125
24 carb	0.111111	0.111111	0.111111	0.111111	0.111111	0.111111	0.125	0.125	0.125
25 carb	0.111111	0.111111	0.111111	0.111111	0.111111	0.111111	0.125	0.125	0.125
26 carb	0.111111	0.111111	0.111111	0.111111	0.111111	0.111111	0.125	0.125	0.125
27 carb	0.111111	0.111111	0.111111	0.111111	0.111111	0.111111	0.125	0.125	0.125
10 PFI	0.111111	0.111111	0.111111	0.111111	0.111111	0.111111	0.125	0.125	0.125
11 PFI	0.111111	0.111111	0.111111	0.111111	0.111111	0.111111	0.125	0.125	0.125
12 PFI	0.111111	0.111111	0.111111	0.111111	0.111111	0.111111	0.125	0.125	0.125
13 PFI	0.111111	0.111111	0.111111	0.111111	0.111111	0.111111	0.125	0.125	0.125
14 PFI	0.111111	0.111111	0.111111	0.111111	0.111111	0.111111	0.125	0.125	0.125
15 PFI	0.111111	0.111111	0.111111	0.111111	0.111111	0.111111	0.125	0.125	0.125
16 PFI	0.111111	0.111111	0.111111	0.111111	0.111111	0.111111	0.125	0.125	0.125
17 PFI	0.111111	0.111111	0.111111	0.111111	0.111111	0.111111	0.125	0.125	0.125
18 PFI	0.111111	0.111111	0.111111	0.111111	0.111111	0.111111	0.125	0.125	0.125
2 TBI	0.111111	0.111111	0.111111	0.111111	0.111111	0.111111	0.125	0.125	0.125
3 TBI	0.111111	0.111111	0.111111	0.111111	0.111111	0.111111	0.125	0.125	0.125
4 TBI	0.111111	0.111111	0.111111	0.111111	0.111111	0.111111	0.125	0.125	0.125
5 TBI	0.111111	0.111111	0.111111	0.111111	0.111111	0.111111	0.125	0.125	0.125
7 TBI	0.111111	0.111111	0.111111	0.111111	0.111111	0.111111	0.125	0.125	0.125
8 TBI	0.111111	0.111111	0.111111	0.111111	0.111111	0.111111	0.125	0.125	0.125
9 TBI	0.111111	0.111111	0.111111	0.111111	0.111111	0.111111	0.125	0.125	0.125
20 TBI	0.111111	0.111111	0.111111	0.111111	0.111111	0.111111	0.125	0.125	0.125

CRC 1986 Intermediate Temperature Drivability Test
Official Data Set

Three runs with high residuals were deleted

ATER	R	S	T
10	0.333333	0.333333	0.333333
50	0.333333	0.333333	0.333333
30	0.333333	0.333333	0.333333
JNTEMP	126.865	126.865	126.865
JNTEMP•FUELTYPE	214.124	214.124	214.124
EtOH	342.202	342.202	342.202
HC	48.5021	48.5021	48.5021
MeOH	48.5021	48.5021	48.5021

CRC 1986 Intermediate Temperature Driveability Test
Official Data Set
Three runs with high residuals were deleted

GENERAL LINEAR MODELS PROCEDURE

LEAST SQUARES MEANS

SYS	FUELTYPE	SQRTTWO LSMEAN	STD ERR LSMEAN	PROB > T H0: LSMEAN=0	LSMEAN NUMBER
carb	EtOH	8.07752834	0.31719063	0	1
carb	HC	7.04023151	0.31762752	59E-74	2
carb	MeOH	9.23808485	0.31449114	0	3
PFI	EtOH	4.55892321	0.31638684	13E-39	4
PFI	HC	3.66517863	0.31708428	46E-28	5
PFI	MeOH	5.25276467	0.31439441	15E-49	6
TBI	EtOH	6.27123533	0.33728491	63E-58	7
TBI	HC	4.93536955	0.33660325	11E-40	8
TBI	MeOH	6.96997968	0.33344676	27E-68	9

PROB > |T| H0: LSMEAN(I)=LSMEAN(J)

I/J	1	2	3	4	5	6	7	8	9
1		0.0213	0.0097	22E-15	13E-21	65E-11	0.0001	42E-12	0.0165
2	0.0213		126E-8	54E-9	33E-14	751E-7	0.0978	708E-8	0.8788
3	0.0097	126E-8		47E-24	12E-31	10E-18	34E-11	55E-20	108E-8
4	22E-15	54E-9	47E-24		0.0471	0.1206	0.0002	0.4168	247E-9
5	13E-21	33E-14	12E-31	0.0471		0.0004	33E-9	0.0058	31E-13
6	65E-11	751E-7	10E-18	0.1206	0.0004		0.0277	0.4910	0.0002
7	0.0001	0.0978	34E-11	0.0002	33E-9	0.0277		0.0053	0.1414
8	42E-12	708E-8	55E-20	0.4168	0.0058	0.4910	0.0053		217E-7
9	0.0165	0.8788	108E-8	247E-9	31E-13	0.0002	0.1414	217E-7	

NOTE: TO ENSURE OVERALL PROTECTION LEVEL, ONLY PROBABILITIES ASSOCIATED WITH PRE-PLANNED COMPARISONS SHOULD BE USED.

CRC 1986 Intermediate Temperature Driveability Test
Official Data Set
Three runs with high residuals were deleted

UNIVARIATE

VARIABLE=R

MOMENTS

466 SUM WGTs 466
MEAN 6.417E-15 SUM 2.990E-12
STD DEV 2.21085 VARIANCE 4.88785
SKEWNESS 0.0934949 KURTOSIS -0.210164
JSS 2272.85 CSS 2272.85
ZV 99999 STD MEAN 0.102416
T:MEAN=0 6.266E-14 PROB>|T| 1
SIGN RANK -271.5 PROB>|S| 0.925767
NUM = 6 466
NORMAL 0.0328133 PROB>D >.15

QUANTILES(DEF=4)

	100% MAX	99%	95%	90%	10%	5%	1%
75% Q3	6.48907	5.62144	5.60935	5.56114			
50% MED	1.55917	3.60935	2.90846	5.74388			
25% Q1	-0.00641064	2.90846	-2.79623	6.07131			
0% MIN	-1.63991	-2.79623	-3.58709	6.30194			
	-5.55701	-3.58709	-5.13409	6.48907			
RANGE	12.0461						
Q3-Q1	3.19908						
MODE	-5.55701						

EXTREMES

	LOWEST	HIGHEST
	-5.55701	5.56114
	-5.34665	5.74388
	-5.21227	6.07131
	-5.18372	6.30194
	-5.10965	6.48907

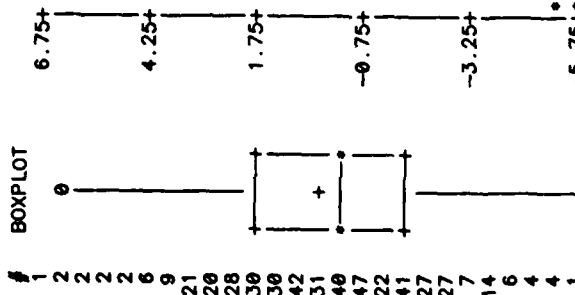
STEM LEAF

```

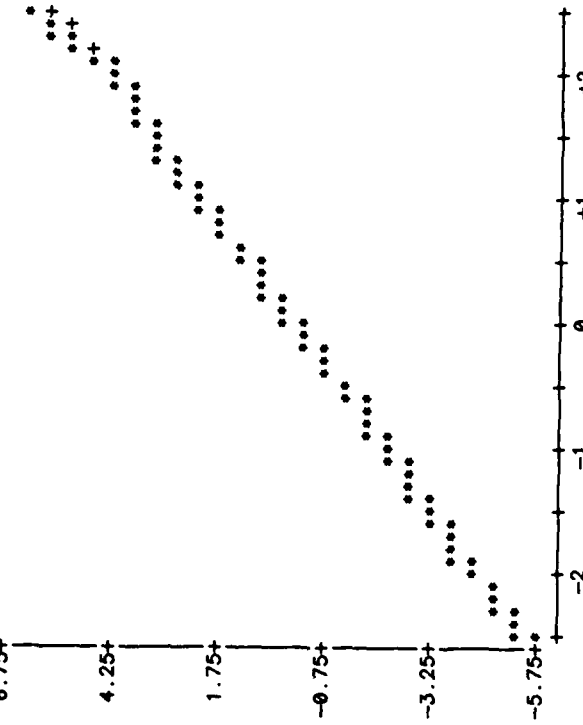
6 5
5 13
5 67
5 13
4 57
4 011344
3 577778999
3 0000111122333344444
2 5555677777888889999
2 000001111222222233334444
1 5555666666777788889999999
1 000000001111111122223334444
0 5555566666777788888888889999999
0 111112222222223333334444444
-0 444444333333332221111110000000000
-0 99999988888888777777766666665555555
-1 4444444333222111100
-1 999998888888777776666665555555555
-2 4444333333332221111000
-2 9999998888777776666555
-3 4443310
-3 9998776655555
-4 322100
-4 9886
-5 3221
-5 6

```

BOXPLOT



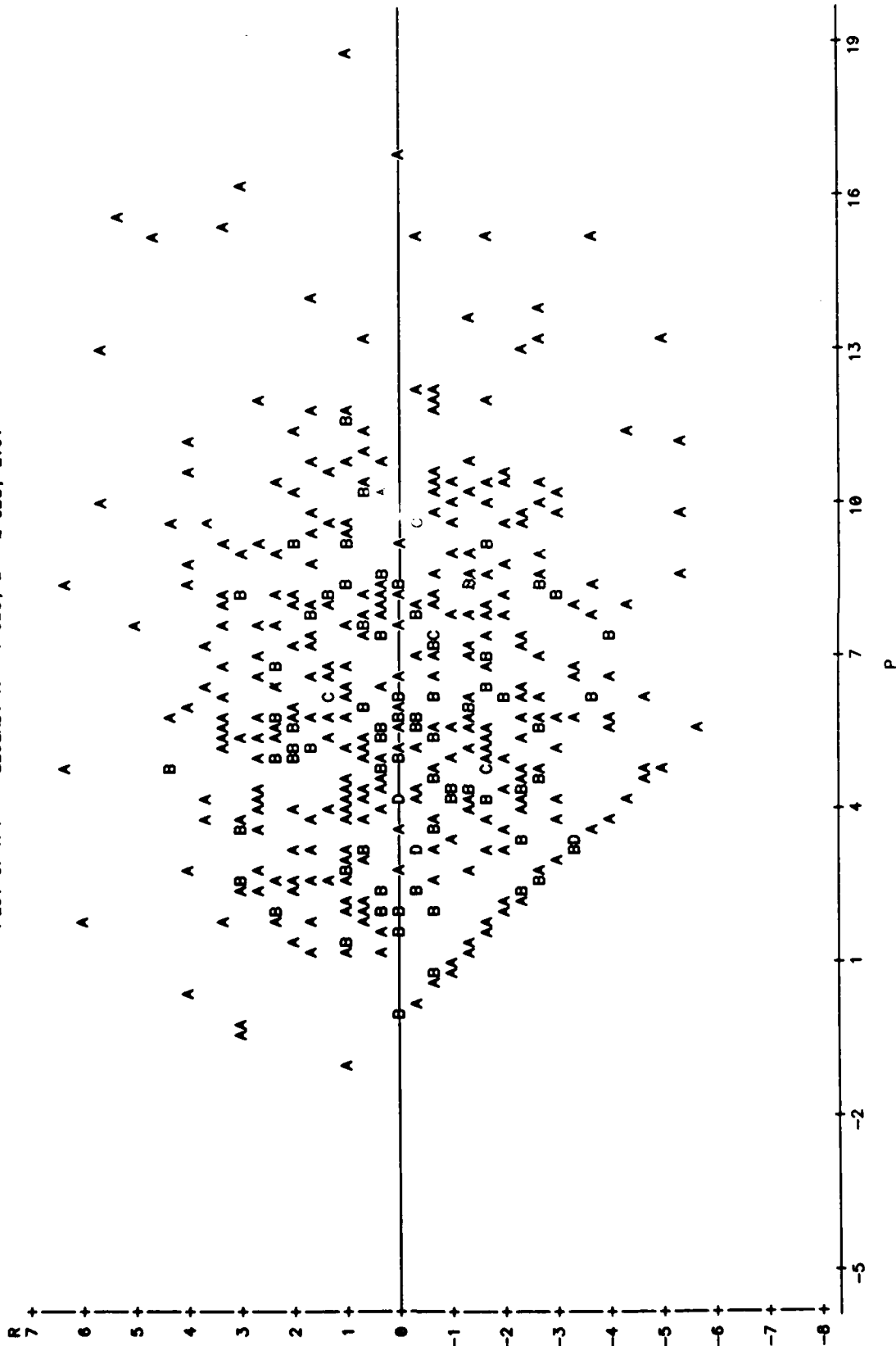
NORMAL PROBABILITY PLOT



CRC 1986 Intermediate Temperature Driveability Test
Official Data Set

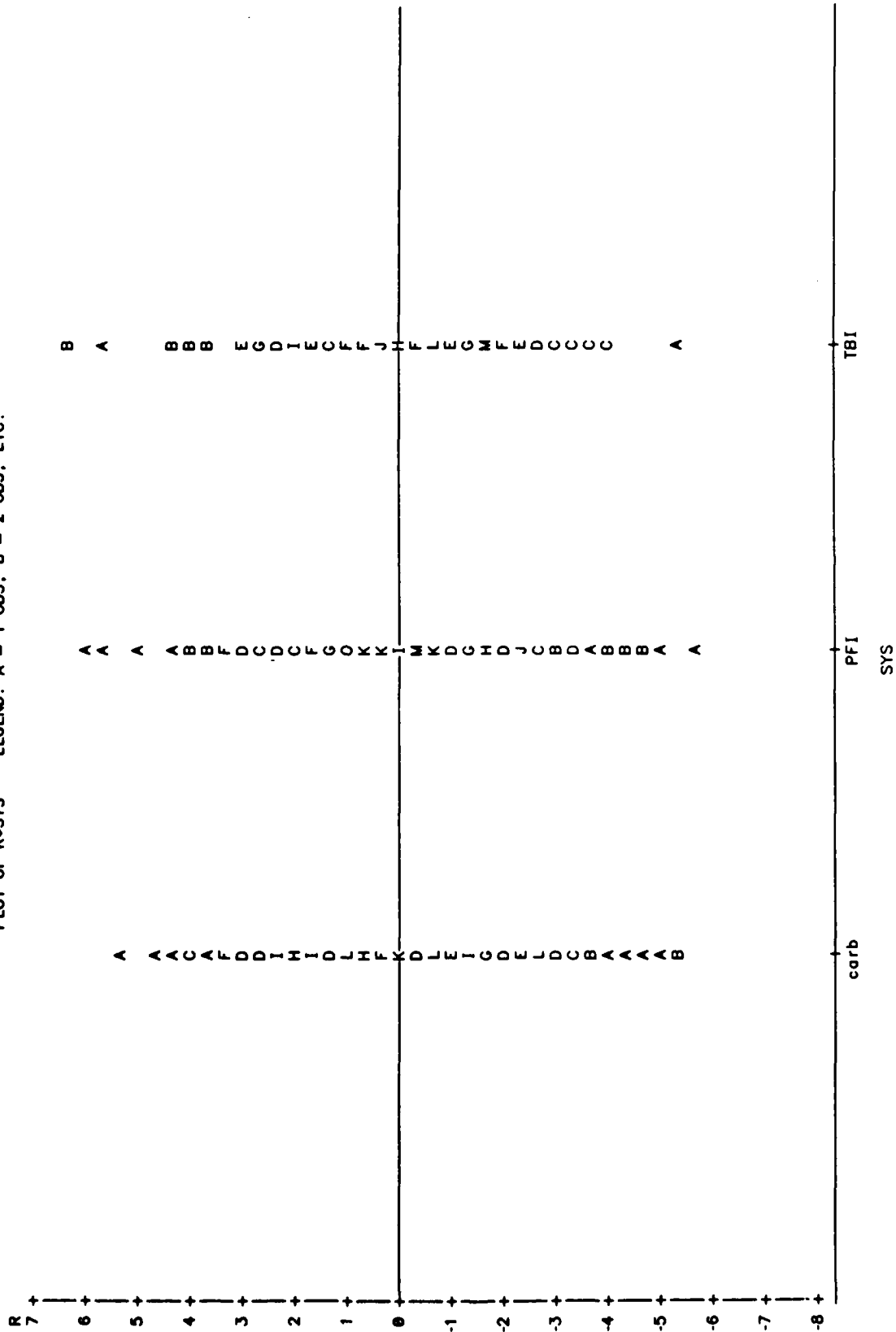
Three runs with high residuals were deleted

PLOT OF R_{OP} LEGEND: A = 1 OBS, B = 2 OBS, ETC.



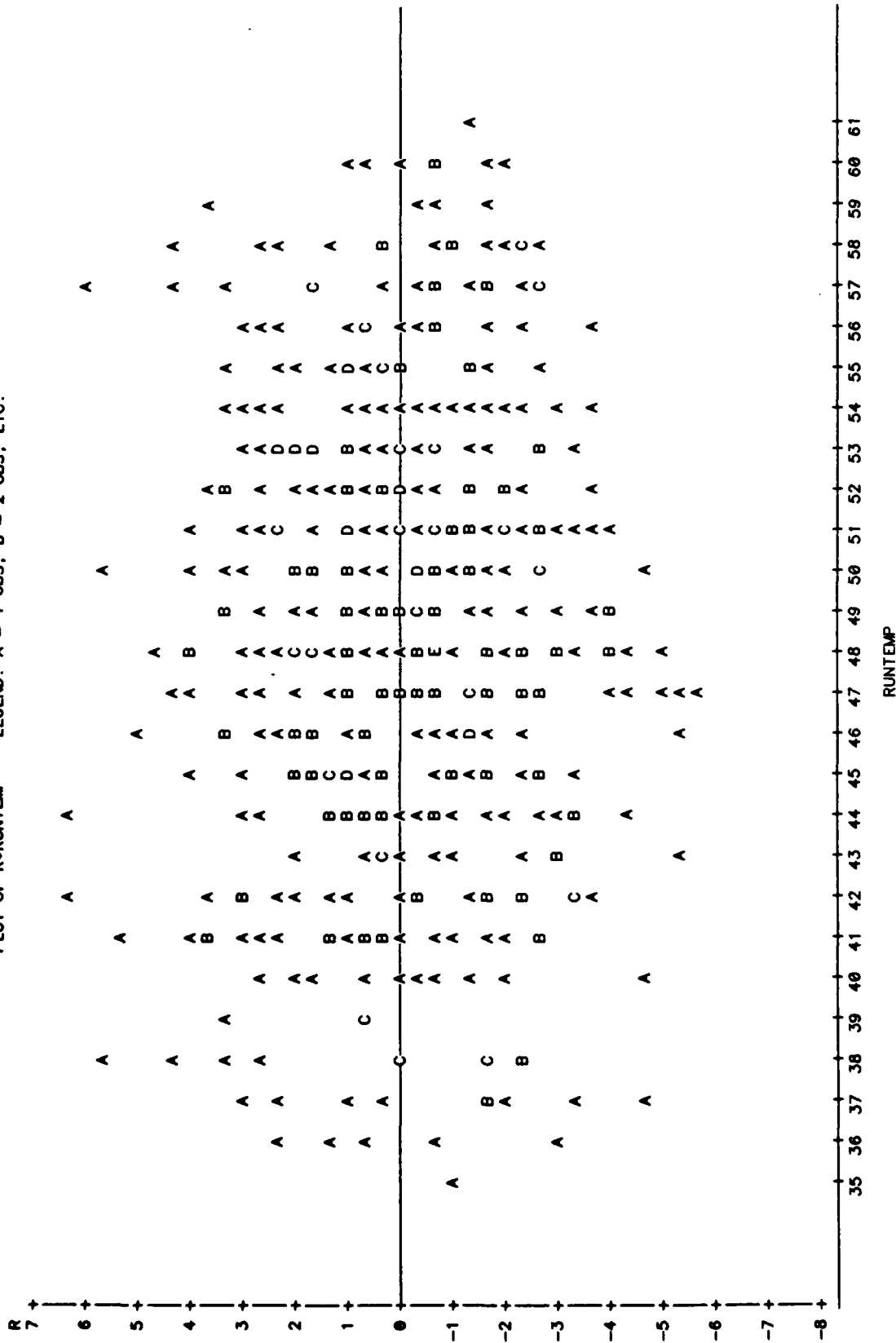
CRC 1986 Intermediate Temperature Drivability Test
Official Data Set
Three runs with high residuals were deleted

PLOT OF R-SYS LEGEND: A = 1 OBS, B = 2 OBS, ETC.



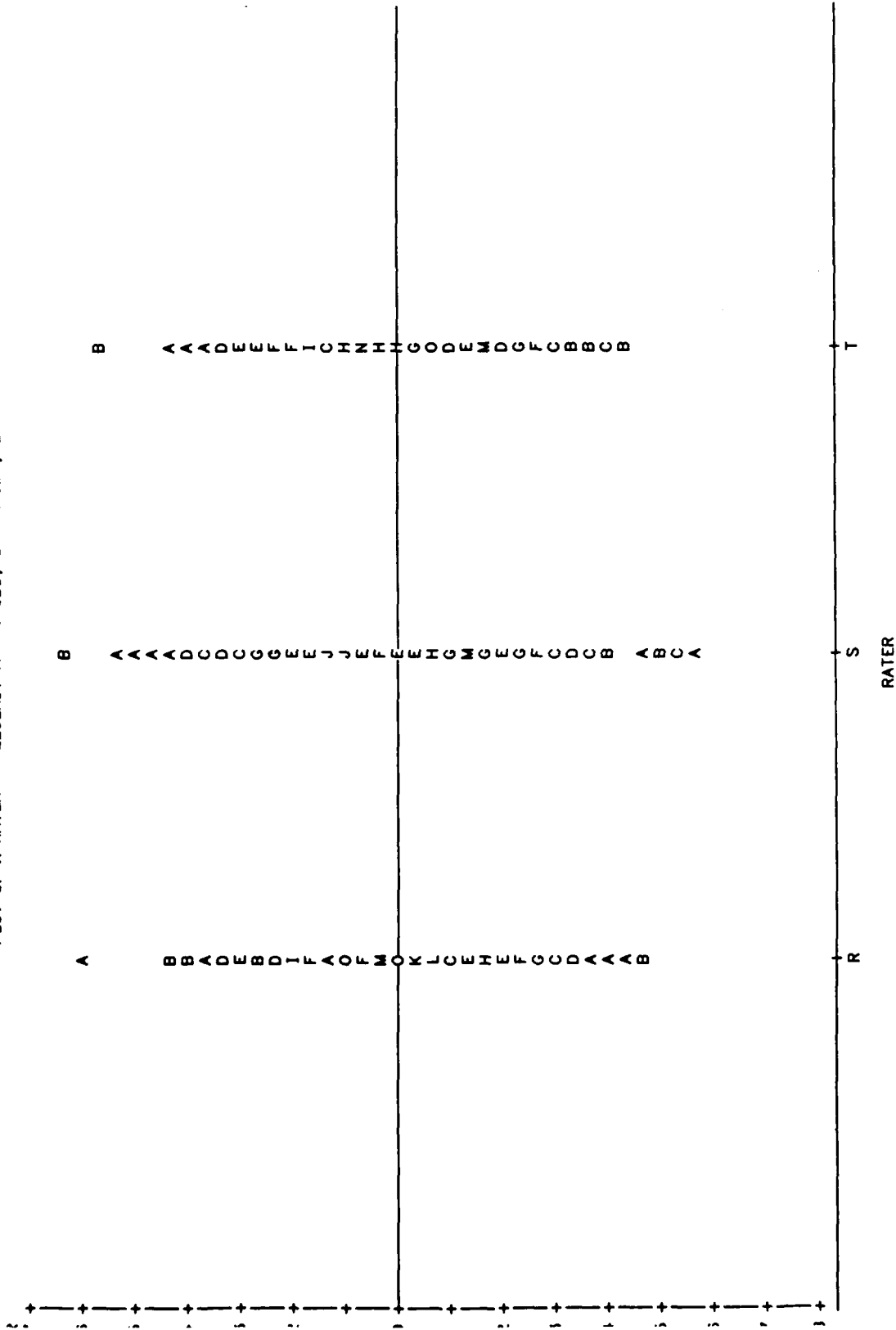
CRC 1986 Intermediate Temperature Drivability Test
Official Data Set
Three runs with high residuals were deleted

PLOT OF R•RUNTEMP LEGEND: A = 1 OBS, B = 2 OBS, ETC.

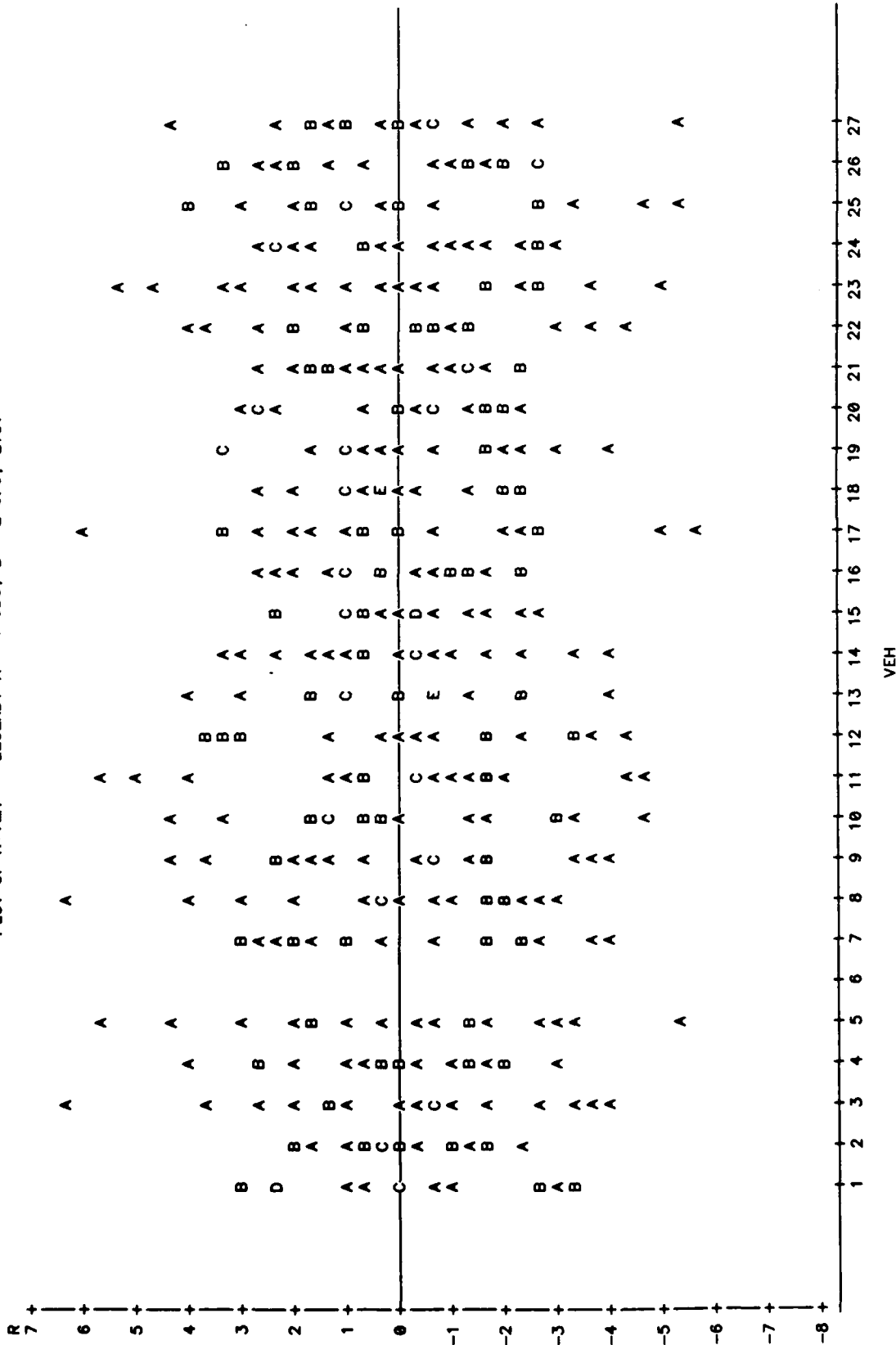


CRC 1986 Intermediate Temperature Drivability Test
 Official Data Set
 Three runs with high residuals were deleted

PLOT OF R•RAT•R LEGEND: A = 1 OBS, B = 2 OBS, ETC.



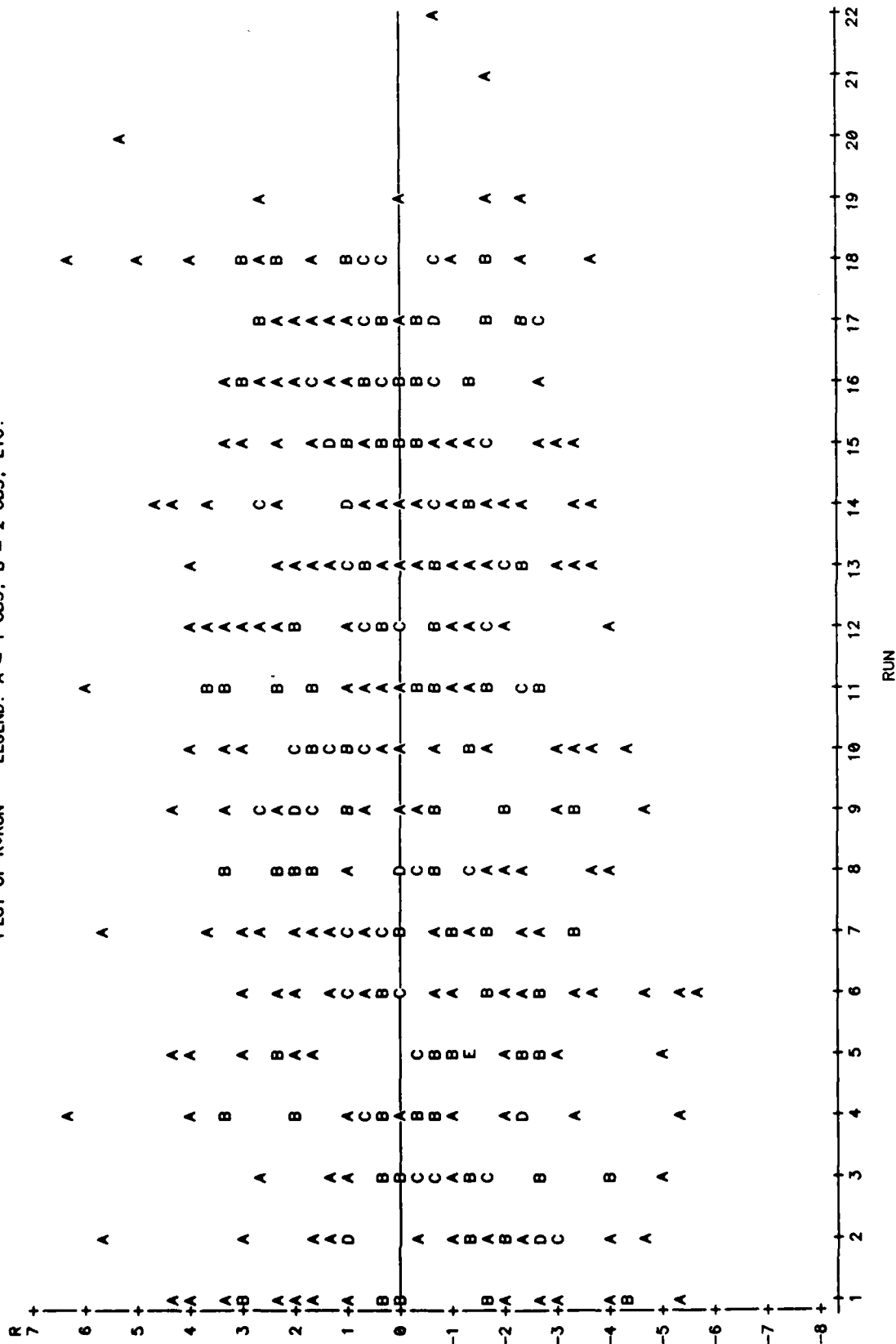
CRC 1986 Intermediate Temperature Driveability Test
 Official Data Set
 Three runs with high residuals were deleted
 PLOT OF R•VEH LEGEND: A = 1 OBS, B = 2 OBS, ETC.



CRC 1986 Intermediate Temperature Driveability Test
Official Data Set

Three runs with high residuals were deleted

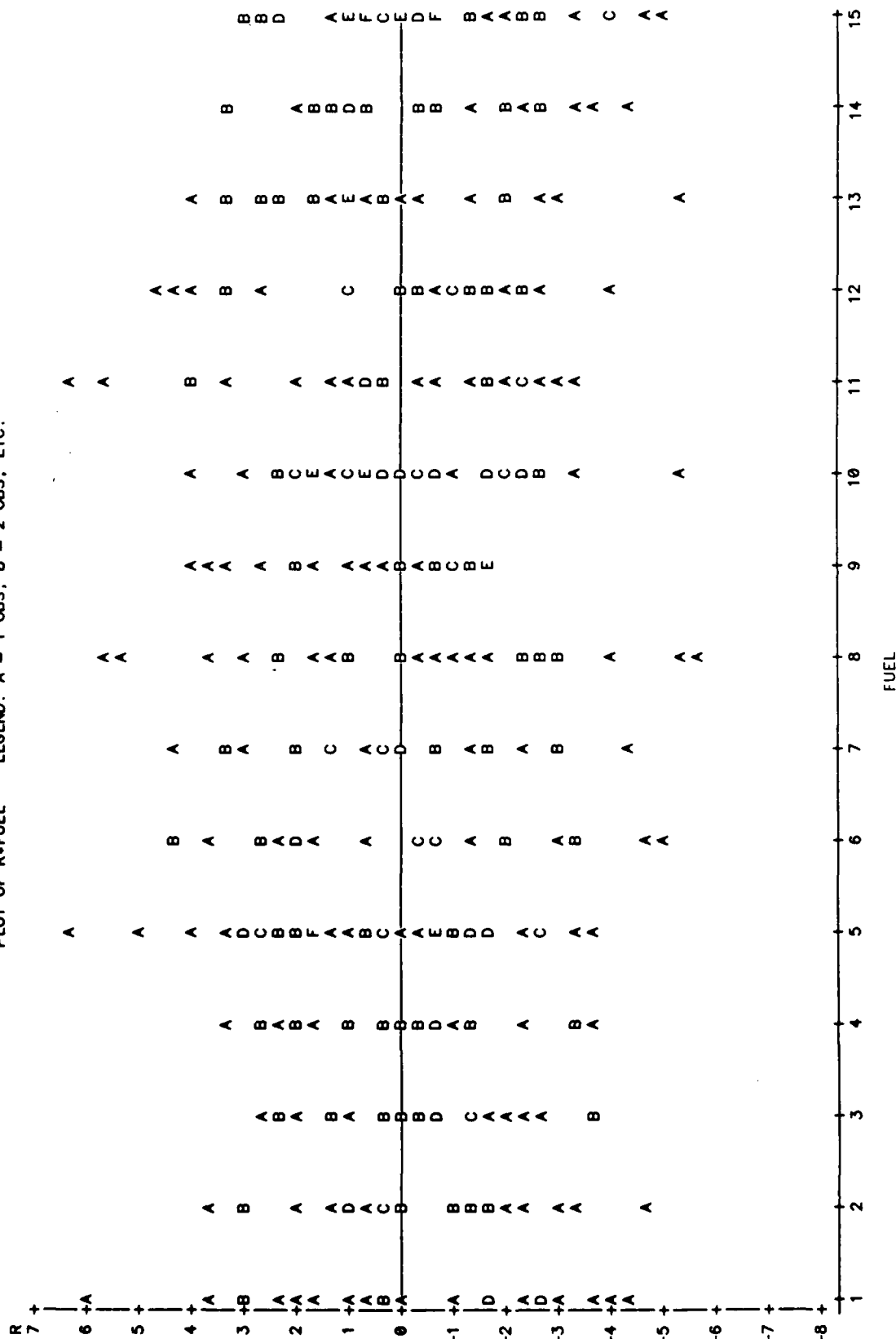
PLOT OF R•RUN LEGEND: A = 1 OBS, B = 2 OBS, ETC.



CRC 1986 Intermediate Temperature Driveability Test
Official Data Set

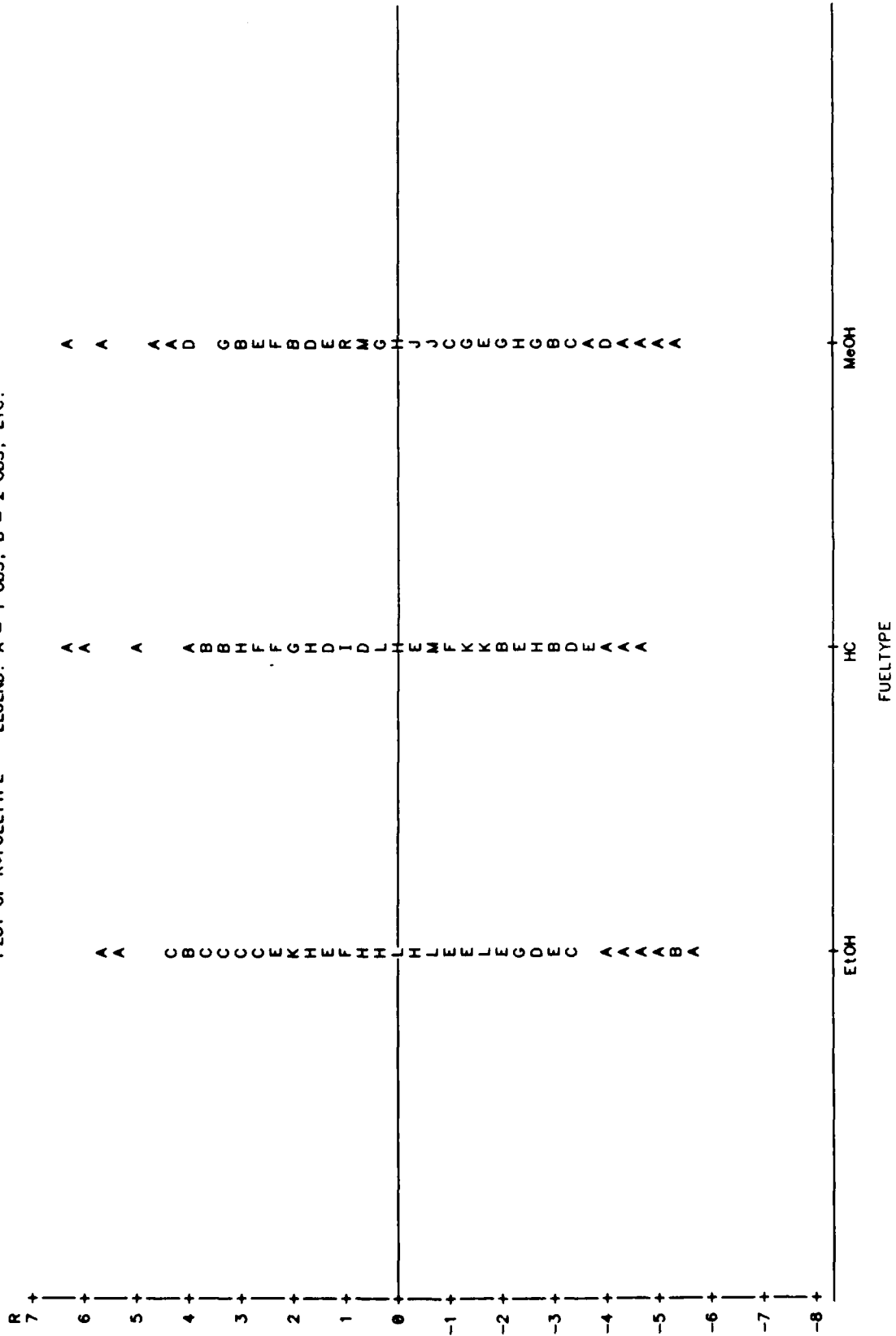
Three runs with high residuals were deleted

PLOT OF R•FUEL LEGEND: A = 1 OBS, B = 2 OBS, ETC.



CRC 1986 Intermediate Temperature Driveability Test
Official Data Set
Three runs with high residuals were deleted

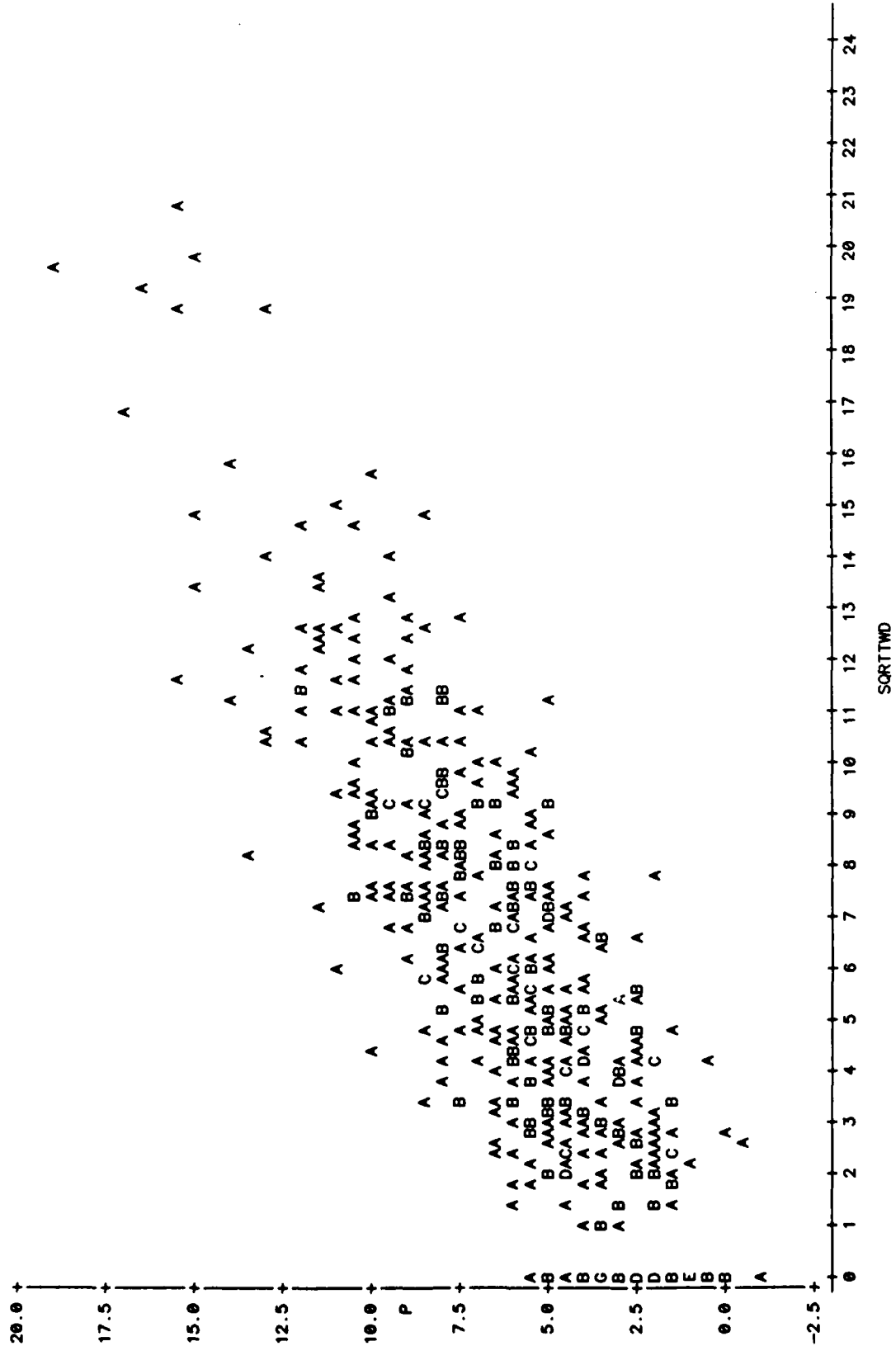
PLOT OF R-FUELTYPE LEGEND: A = 1 OBS, B = 2 OBS, ETC.



CRC 1986 Intermediate Temperature Driveability Test
Official Data Set

Three runs with high residuals were deleted

PLOT OF P-SORTTWO LEGEND: A = 1 OBS. B = 2 OBS. ETC.



The following runs were deleted from this model

OBS	PRGM_YR	VEH	FUEL	RUN	RATER	RUNTEMP	CTWD	HTWD	SORTTWD	LOG1TWD	SYS	TEMP	FUELTYPE	VOL	T10	T50	T90	RVP
1	1986	19	5	18	S	36	429	23	20.7123	6.06379	carb	med	HC	5.10_15	127	214	344	9.4
2	1986	5	9	3	R	55	472	156	21.7256	6.15910	TBI	med	EtOH	4.9_14	112	234	324	13.3
3	1986	13	10	20	S	48	152	0	12.3288	5.03044	PFI	med	EtOH	5.10_15	129	211	344	10.3

CRC 1987 Low Temperature Drivability Test
 Official Data Set
 All four runs with No-Starts are deleted

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS	LEVELS	VALUES
VEH	27	41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 63 64 65 66 67 68
SYS	3	carb PFI TBI
FUELTYPE	3	EtOH HC MeOH
RATER	4	R S T U

NUMBER OF OBSERVATIONS IN DATA SET = 482

CRC 1987 Low Temperature Driveability Test
 Official Data Set
 All four runs with No-Starts are deleted

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: SORTW2D

SOURCE	TYPE III EXPECTED MEAN SQUARE
FUELTYPE	VAR(ERROR) + Q(FUELTYPE, SYS*FUELTYPE)
SYS	VAR(ERROR) + 17.7778291 VAR(VEH(SYS)) + Q(SYS, SYS*FUELTYPE)
SYS*FUELTYPE	VAR(ERROR) + Q(SYS*FUELTYPE)
VEH(SYS)	VAR(ERROR) + 17.6876932 VAR(VEH(SYS))
RATER	VAR(ERROR) + 113.968379 VAR(RATER)
T10	VAR(ERROR) + Q(T10)
T50	VAR(ERROR) + Q(T50)
T90	VAR(ERROR) + Q(T90)
RUNTEMP	VAR(ERROR) + Q(RUNTEMP, RUNTEMP*FUELTYPE)
RUNTEMP*FUELTYPE	VAR(ERROR) + Q(RUNTEMP*FUELTYPE)
CONTRAST	EXPECTED MEAN SQUARE
ratio	VAR(ERROR) + Q(T10, T50, T90)

CRC 1987 Low Temperature Drivability Test
Official Data Set
All four runs with No-Starts are deleted

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: SORTTWD				
SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE
MODEL	41	5045.86080686	123.06977578	24.87
ERROR	440	2177.63200347	4.94916364	
CORRECTED TOTAL	481	7223.49281034		
			ROOT MSE	PR > F
			2.22467158	1E-70
				R-SQUARE
				0.698535
				C.V.
				21.9220
				SQRTTWD MEAN
				10.14812568

SOURCE	DF	TYPE III SS	F VALUE	PR > F
FUELTYPE	2	22.35623017	2.26	0.1057
SYS	2	927.36311055	93.69	13E-35
SYS*FUELTYPE	4	36.16659601	1.83	0.1226
VEH(SYS)	24	1145.68931676	9.65	72E-29
RATER	3	2562.93937378	172.62	1E-70
T10	1	101.66915586	20.54	753E-8
T50	1	125.08853371	25.27	725E-9
T90	1	39.23669067	7.93	0.0051
RUNTEMP	1	56.00550148	11.32	0.0008
RUNTEMP*FUELTYPE	2	1.18135058	0.12	0.8875

CONTRAST	DF	SS	F VALUE	PR > F
ratio	2	17.19836126	1.74	0.1772

TESTS OF HYPOTHESES USING THE TYPE III MS FOR VEH(SYS) AS AN ERROR TERM

SOURCE	DF	TYPE III SS	F VALUE	PR > F
SYS	2	927.36311055	9.71	0.0008

PARAMETER	ESTIMATE	T FOR H0: PARAMETER=0	PR > T	STD ERROR OF ESTIMATE
INTERCEPT	-9.57470186 B	-3.56	0.0004	2.69165597
FUELTYPE	-1.20568080 B	-1.55	0.1228	0.77987486
	-1.5194914 B	-2.10	0.0364	0.72415189
SYS	0.00000000 B	0.0000	0.0003	0.83686326
	-3.04625002 B	-3.64	0.0003	0.83686326
	-3.63279077 B	-4.34	177E-7	0.83686326
	0.00000000 B	0.0000	0.0003	0.83686326
SYS*FUELTYPE	1.42942217 B	2.31	0.0213	0.61874489
	0.21387846 B	0.35	0.7261	0.61018067
	0.00000000 B	0.0000	0.0003	0.61018067
	1.18671009 B	1.91	0.0565	0.62051019
	0.54437704 B	0.89	0.3715	0.60851634
	0.00000000 B	0.0000	0.0003	0.60851634

CRC 1987 Low Temperature Driveability Test
Official Data Set
All four runs with No-Starts are deleted

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: SORTTWO

PARAMETER	ESTIMATE	T FOR H0: PARAMETER=0	PR > T	STD ERROR OF ESTIMATE
EH(SYS)				
TBI EtOH	0.00000000 B			
TBI HC	0.00000000 B			
TBI MeOH	0.00000000 B			
50 carb	5.86511155 B	7.88	26E-15	0.74428399
60 carb	4.21281095 B	5.66	28E-9	0.74453111
61 carb	6.77149874 B	9.09	33E-19	0.74466708
63 carb	4.10819244 B	5.42	97E-9	0.75758643
64 carb	7.12081773 B	9.53	11E-20	0.74718689
65 carb	4.72457955 B	6.37	48E-11	0.74164579
66 carb	2.01674082 B	2.72	0.0068	0.74206109
67 carb	4.36282168 B	5.88	82E-10	0.74224883
68 carb	0.00000000 B			
50 PFI	2.28121209 B	3.07	0.0023	0.74423390
51 PFI	2.06141645 B	2.73	0.0068	0.75579139
52 PFI	0.70079567 B	0.94	0.3468	0.74410909
53 PFI	1.62667162 B	2.15	0.0323	0.75736828
54 PFI	3.81018847 B	5.02	749E-9	0.75887960
55 PFI	-0.58245676 B	-0.78	0.4359	0.74680747
56 PFI	1.45985800 B	1.97	0.0497	0.74197019
57 PFI	3.03472538 B	4.09	514E-7	0.74209074
58 PFI	0.00000000 B			
41 TBI	-2.14369997 B	-2.88	0.0042	0.74450573
42 TBI	0.72691955 B	0.98	0.3292	0.74417047
43 TBI	-0.73095595 B	-0.98	0.3264	0.74391032
44 TBI	-2.05257302 B	-2.74	0.0063	0.74803737
45 TBI	0.14911556 B	0.20	0.8422	0.74846942
46 TBI	-0.60566725 B	-0.81	0.4186	0.74801673
47 TBI	0.41970978 B	0.57	0.5720	0.74205489
48 TBI	-0.26005478 B	-0.35	0.7262	0.74202301
49 TBI	0.00000000 B			
ATER				
R	1.10584667 B	3.52	0.0005	0.31378766
S	5.89134439 B	18.63	15E-58	0.31618756
T	3.74093128 B	10.43	66E-24	0.35066648
U	0.00000000 B			
10	0.03778339	4.53	753E-8	0.00833628
50	0.04176240	5.03	725E-9	0.00830697
90	0.01399633	2.82	0.0051	0.00497089
UNTEMP	-0.03060129 B	-1.50	0.1344	0.02044635
UNTEMP*FUELTYPE	-0.01311845 B	-0.46	0.6430	0.02828531
EtOH	-0.00329836 B	-0.13	0.8994	0.02606732
HC				
MeOH	0.00000000 B			

OTE: THE X'X MATRIX HAS BEEN DEEMED SINGULAR AND A GENERALIZED INVERSE HAS BEEN EMPLOYED TO SOLVE THE NORMAL EQUATIONS. THE ABOVE ESTIMATES REPRESENT ONLY ONE OF MANY POSSIBLE SOLUTIONS TO THE NORMAL EQUATIONS. ESTIMATES FOLLOWED BY THE LETTER B ARE BIASED AND DO NOT ESTIMATE THE PARAMETER BUT ARE BLUE FOR SOME LINEAR COMBINATION OF PARAMETERS (OR ARE ZERO). THE EXPECTED VALUE OF THE BIASED ESTIMATORS MAY BE OBTAINED FROM THE GENERAL FORM OF ESTIMABLE FUNCTIONS. FOR THE BIASED ESTIMATORS, THE STD ERR IS THAT OF THE BIASED ESTIMATOR AND THE T VALUE TESTS H0: E(BIASED ESTIMATOR) = 0. ESTIMATES NOT FOLLOWED BY THE LETTER B ARE BLUE FOR THE PARAMETER.

CRC 1987 Low Temperature Driveability Test
Official Data Set
All four runs with No-Starts are deleted

GENERAL LINEAR MODELS PROCEDURE

STANDARD ERRORS AND PROBABILITIES CALCULATED USING THE TYPE III MS FOR VEH(SYS) AS AN ERROR TERM

SYS SORTTWO LSMEAN STD ERR LSMEAN H0:LSMEAN=0 PROB > |T| I/J H0: LSMEAN(1)=LSMEAN(J)

carb 11.7572625 0.5591288 57E-18 1 0.0003 0.0054
PFI 8.4455437 0.5607688 99E-15 2 0.0003 0.2275
TBI 9.4024590 0.5554992 76E-16 3 0.0054 0.2275

NOTE: TO ENSURE OVERALL PROTECTION LEVEL, ONLY PROBABILITIES ASSOCIATED WITH PRE-PLANNED COMPARISONS SHOULD BE USED.

FUELTYPE SORTTWO LSMEAN STD ERR LSMEAN H0:LSMEAN=0 PROB > |T| I/J H0: LSMEAN(1)=LSMEAN(J)

E1OH 9.8928284 0.1822929 0 1 0.0046 0.0136
HC 9.1850094 0.1765963 0 2 0.0046 160E-9
MeOH 10.5274274 0.1853675 0 3 0.0136 160E-9

NOTE: TO ENSURE OVERALL PROTECTION LEVEL, ONLY PROBABILITIES ASSOCIATED WITH PRE-PLANNED COMPARISONS SHOULD BE USED.

CRC 1987 Low Temperature Driveability Test
Official Data Set
All four runs with No-Starts are deleted

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: SORTTWD

ESTIMABLE FUNCTIONS FOR SYS=FUELTYPE LEAST SQUARES MEANS

SYS FUELTYPE	EFFECT INTERCEPT	curb EtOH	curb HC	curb MeOH	PFI EtOH	PFI HC	PFI MeOH	TBI EtOH	TBI HC	TBI MeOH
		COEFFICIENTS								
		1	1	1	1	1	1	1	1	1
	EtOH	1	0	0	1	0	0	1	0	0
	HC	0	1	0	0	1	0	0	1	0
	MeOH	0	0	1	0	0	1	0	0	1
SYS	carb	1	1	1	0	0	0	0	0	0
	PFI	0	0	0	1	1	1	0	0	0
	TBI	0	0	0	0	0	0	1	1	1
SYS=FUELTYPE	carb EtOH	1	0	0	0	0	0	0	0	0
	carb HC	0	1	0	0	0	0	0	0	0
	carb MeOH	0	0	1	0	0	0	0	0	0
	PFI EtOH	0	0	0	1	0	0	0	0	0
	PFI HC	0	0	0	0	1	0	0	0	0
	PFI MeOH	0	0	0	0	0	1	0	0	0
	TBI EtOH	0	0	0	0	0	0	1	0	0
	TBI HC	0	0	0	0	0	0	0	1	0
	TBI MeOH	0	0	0	0	0	0	0	0	1
VEH(SYS)	59 carb	0.111111	0.111111	0.111111	0	0	0	0	0	0
	60 carb	0.111111	0.111111	0.111111	0	0	0	0	0	0
	61 carb	0.111111	0.111111	0.111111	0	0	0	0	0	0
	63 carb	0.111111	0.111111	0.111111	0	0	0	0	0	0
	64 carb	0.111111	0.111111	0.111111	0	0	0	0	0	0
	65 carb	0.111111	0.111111	0.111111	0	0	0	0	0	0
	66 carb	0.111111	0.111111	0.111111	0	0	0	0	0	0
	67 carb	0.111111	0.111111	0.111111	0	0	0	0	0	0
	68 carb	0.111111	0.111111	0.111111	0	0	0	0	0	0
	50 PFI	0	0	0	0.111111	0.111111	0.111111	0	0	0
	51 PFI	0	0	0	0.111111	0.111111	0.111111	0	0	0
	52 PFI	0	0	0	0.111111	0.111111	0.111111	0	0	0
	53 PFI	0	0	0	0.111111	0.111111	0.111111	0	0	0
	54 PFI	0	0	0	0.111111	0.111111	0.111111	0	0	0
	55 PFI	0	0	0	0.111111	0.111111	0.111111	0	0	0
	56 PFI	0	0	0	0.111111	0.111111	0.111111	0	0	0
	57 PFI	0	0	0	0.111111	0.111111	0.111111	0	0	0
	58 PFI	0	0	0	0.111111	0.111111	0.111111	0	0	0
	41 TBI	0	0	0	0	0	0	0.111111	0.111111	0.111111
	42 TBI	0	0	0	0	0	0	0.111111	0.111111	0.111111
	43 TBI	0	0	0	0	0	0	0.111111	0.111111	0.111111
	44 TBI	0	0	0	0	0	0	0.111111	0.111111	0.111111
	45 TBI	0	0	0	0	0	0	0.111111	0.111111	0.111111
	46 TBI	0	0	0	0	0	0	0.111111	0.111111	0.111111
	47 TBI	0	0	0	0	0	0	0.111111	0.111111	0.111111
	48 TBI	0	0	0	0	0	0	0.111111	0.111111	0.111111

CRC 1987 Low Temperature Driveability Test
Official Data Set
All four runs with No-Starts are deleted

GENERAL LINEAR MODELS PROCEDURE

LEAST SQUARES MEANS

SYS	FUELTYPE	SQRTTWO LSMEAN	STD ERR LSMEAN	PROB > T H0: LSMEAN=0	LSMEAN NUMBER
carb	EtOH	12.1662124	0.3071936	0	1
carb	HC	10.8621419	0.3012348	0	2
carb	MeOH	12.2434333	0.3182706	0	3
PFI	EtOH	8.5825193	0.3140574	0	4
PFI	HC	7.8516594	0.3003226	0	5
PFI	MeOH	8.9024523	0.3147863	0	6
TBI	EtOH	8.9297536	0.3061630	0	7
TBI	HC	8.8412268	0.2983948	0	8
TBI	MeOH	10.4363967	0.3142977	0	9

PROB > |T| H0: LSMEAN(I)=LSMEAN(J)

I/J	1	2	3	4	5	6	7	8	9
1		0.0024	0.8611	16E-16	89E-23	44E-14	28E-14	37E-15	869E-7
2	0.0024		0.0017	204E-9	39E-13	786E-8	747E-8	196E-8	0.3260
3	0.8611	0.0017		22E-16	12E-22	28E-14	27E-14	36E-15	552E-7
4	16E-16	204E-9	22E-16		0.0919	0.4704	0.4248	0.5477	324E-7
5	89E-23	39E-13	12E-22	0.0919		0.0155	0.0117	0.0187	46E-10
6	44E-14	786E-8	28E-14	0.4704	0.0155		0.9502	0.8872	0.0006
7	28E-14	747E-8	27E-14	0.4248	0.0117	0.9502		0.8351	0.0006
8	37E-15	196E-8	36E-15	0.5477	0.0187	0.8872	0.8351		0.0002
9	869E-7	0.3260	552E-7	324E-7	46E-10	0.0006	0.0006	0.0002	

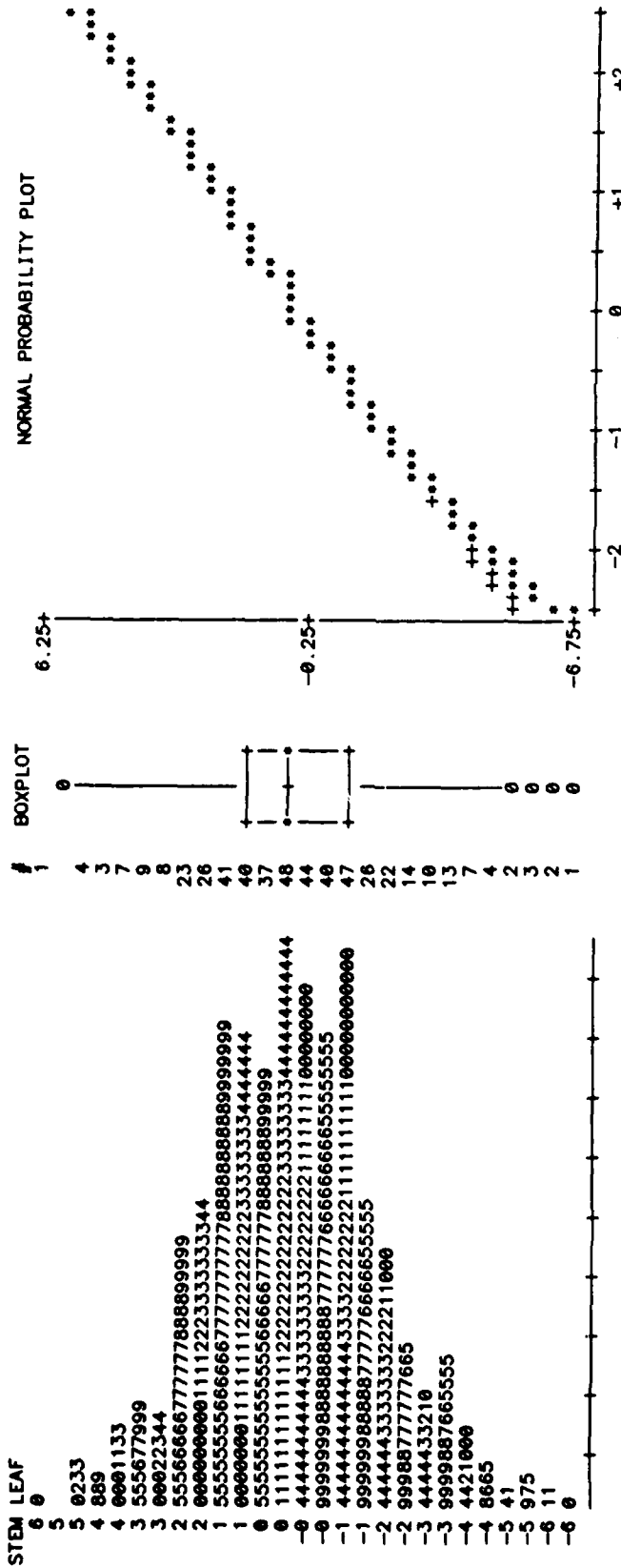
NOTE: TO ENSURE OVERALL PROTECTION LEVEL, ONLY PROBABILITIES ASSOCIATED WITH PRE-PLANNED COMPARISONS SHOULD BE USED.

CRC 1987 Low Temperature Driveability Test
Official Data Set
All four runs with No-Starts are deleted

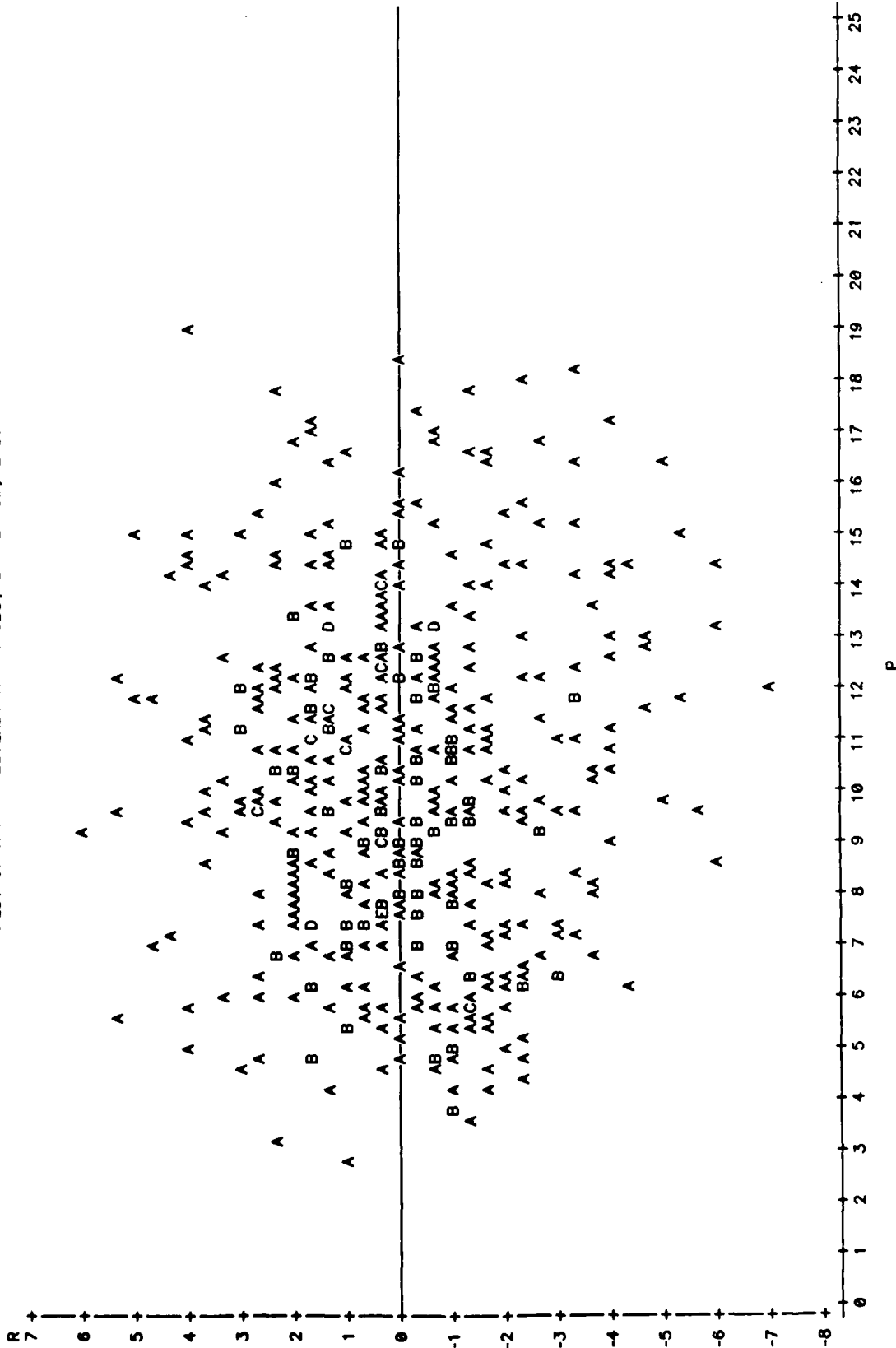
UNIVARIATE

VARIABLE=R

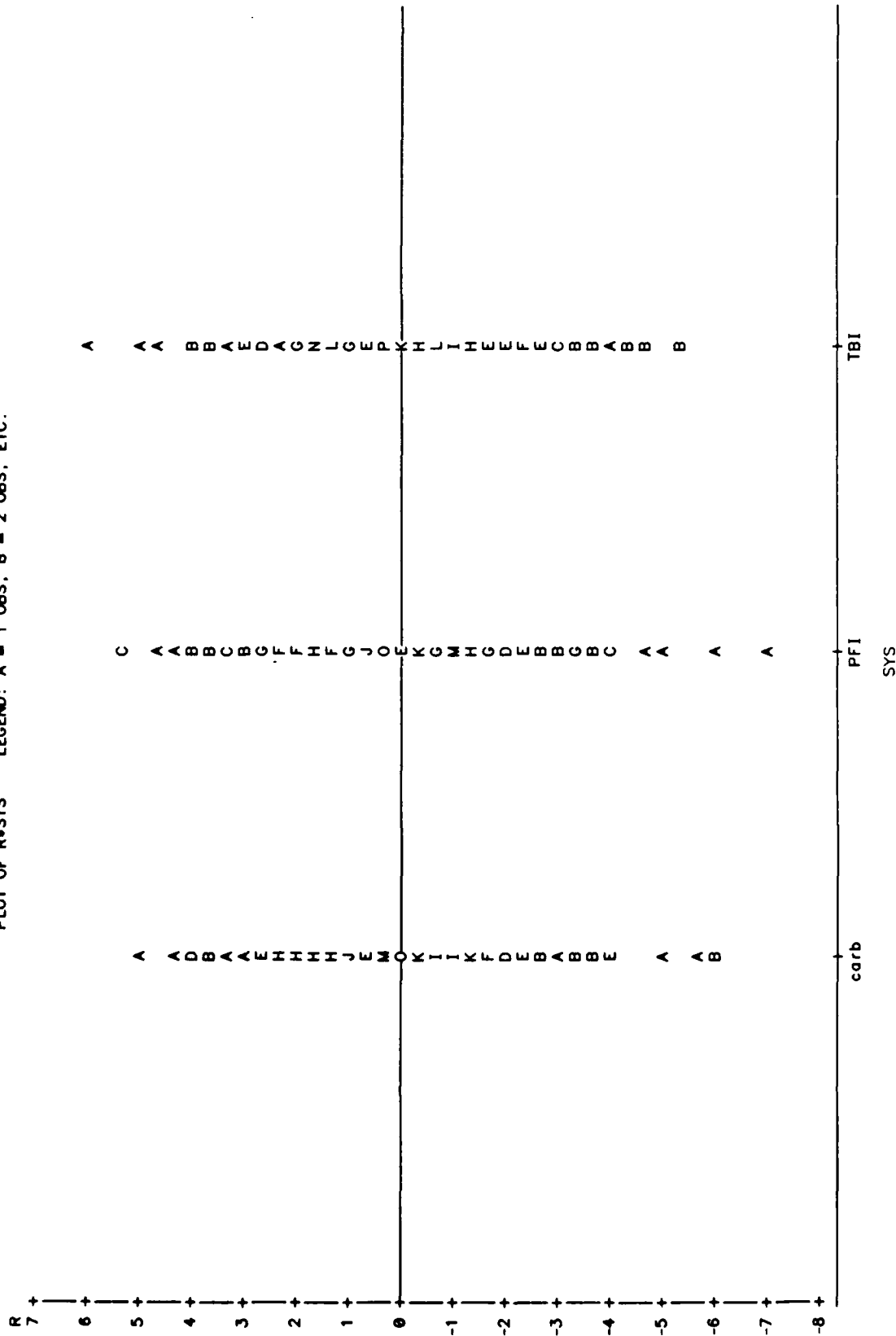
MOMENTS				QUANTILES(DEF=4)				EXTREMES	
N	482	SUM	WCTS	100% MAX	5.96543	99%	5.06277	LOWEST	HIGHEST
MEAN	8.902E-14	SUM		75% Q3	1.47969	95%	3.51337	-6.95081	5.03578
STD DEV	2.12775	VARIANCE		50% MED	0.0814987	90%	2.62394	-6.12242	5.19454
SKEWNESS	-0.208366	KURTOSIS		25% Q1	-1.2657	10%	-2.72861	-6.05079	5.27918
USS	2177.63	CSS		0% MIN	-6.95081	5%	-3.81498	-5.90911	5.30458
CV	99999	STD MEAN		RANGE	12.9162	1%	-5.71995	-5.6812	5.96543
T-MEAN=0	9.185E-13	PROB> T		Q3-Q1	2.74539				
SGN RANK	1396.5	PROB> S		MODE	-6.95081				
NUM = 0	482								
D-NORMAL	0.0336571	PROB>D							



CRC 1987 Low Temperature Driveability Test
 Official Data Set
 All four runs with No-Starts are deleted
 PLOT OF R•P LEGEND: A = 1 OBS, B = 2 OBS, ETC.



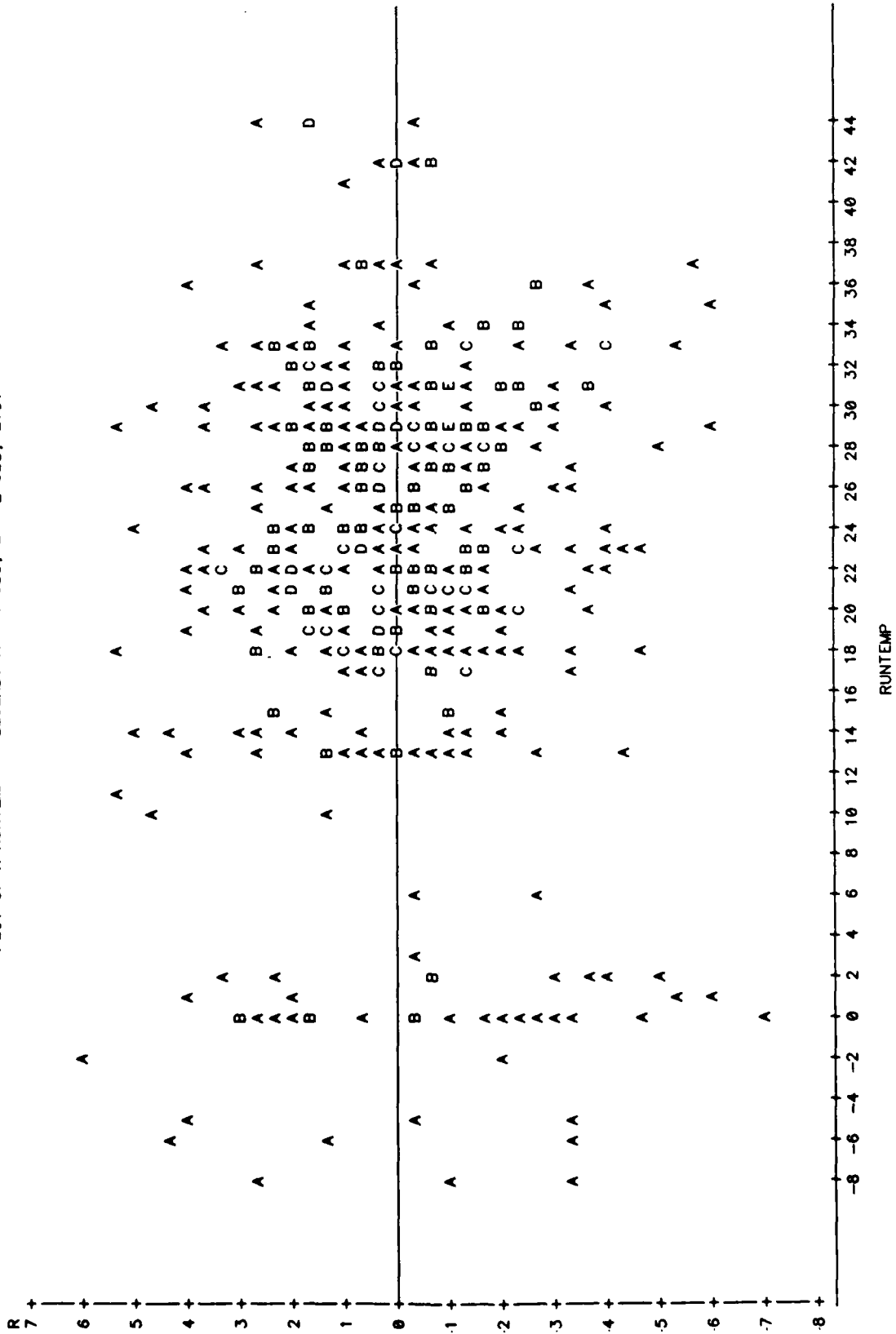
CRC 1987 Low Temperature Driveability Test
 Official Data Set
 All four runs with No-Starts are deleted
 PLOT OF R+SYS LEGEND: A = 1 OBS, B = 2 OBS, ETC.



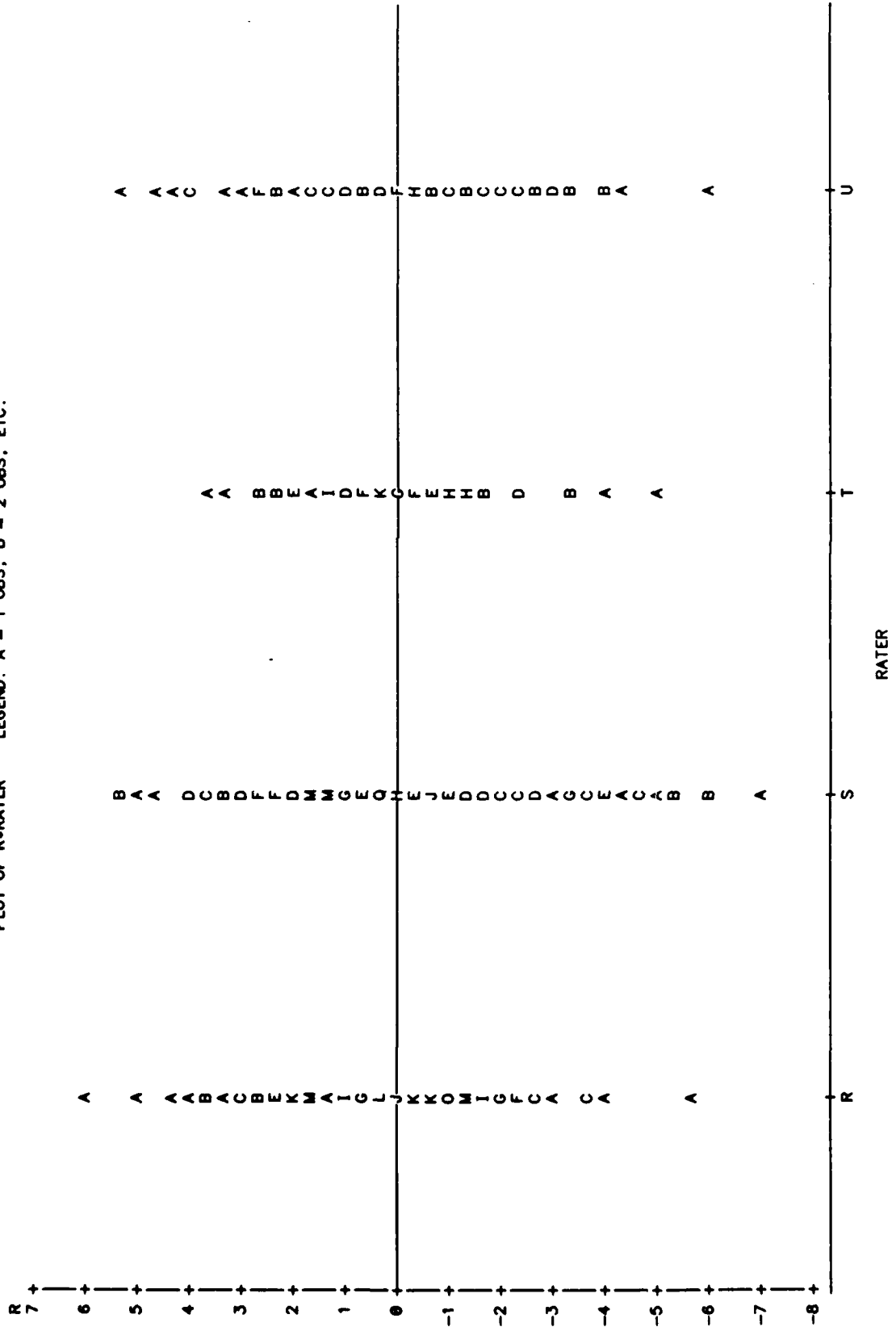
CRC 1987 Low Temperature Driveability Test
Official Data Set

All four runs with No-Starts are deleted

PLOT OF R•RUNTEMP LEGEND: A = 1 OBS, B = 2 OBS, ETC.



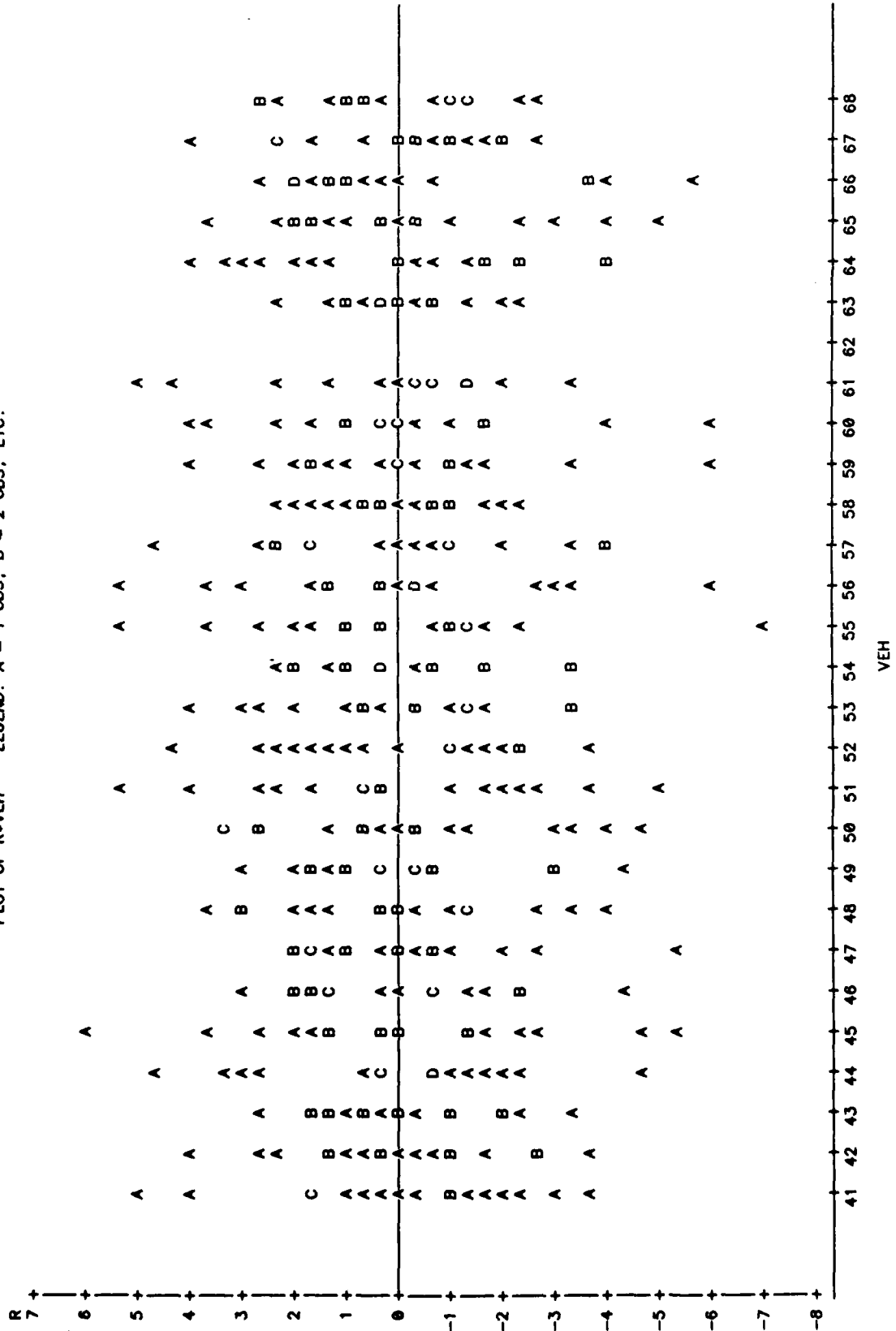
CRC 1987 Low Temperature Driveability Test
 Official Data Set
 All four runs with No-Starts are deleted
 PLOT OF R-RATER LEGEND: A = 1 OBS, B = 2 OBS, ETC.



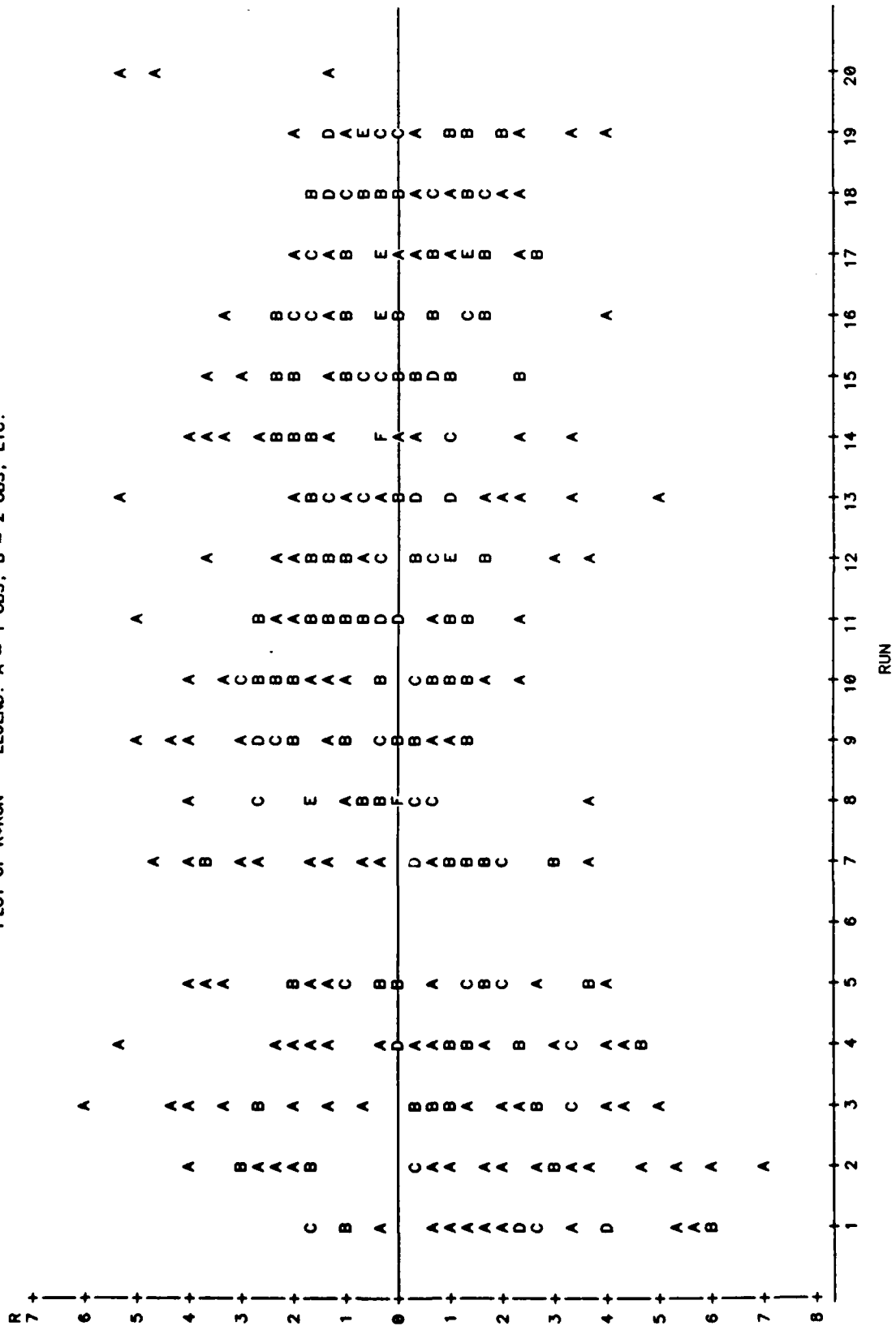
CRC 1987 Low Temperature Driveability Test
Official Data Set

All four runs with No-Starts are deleted

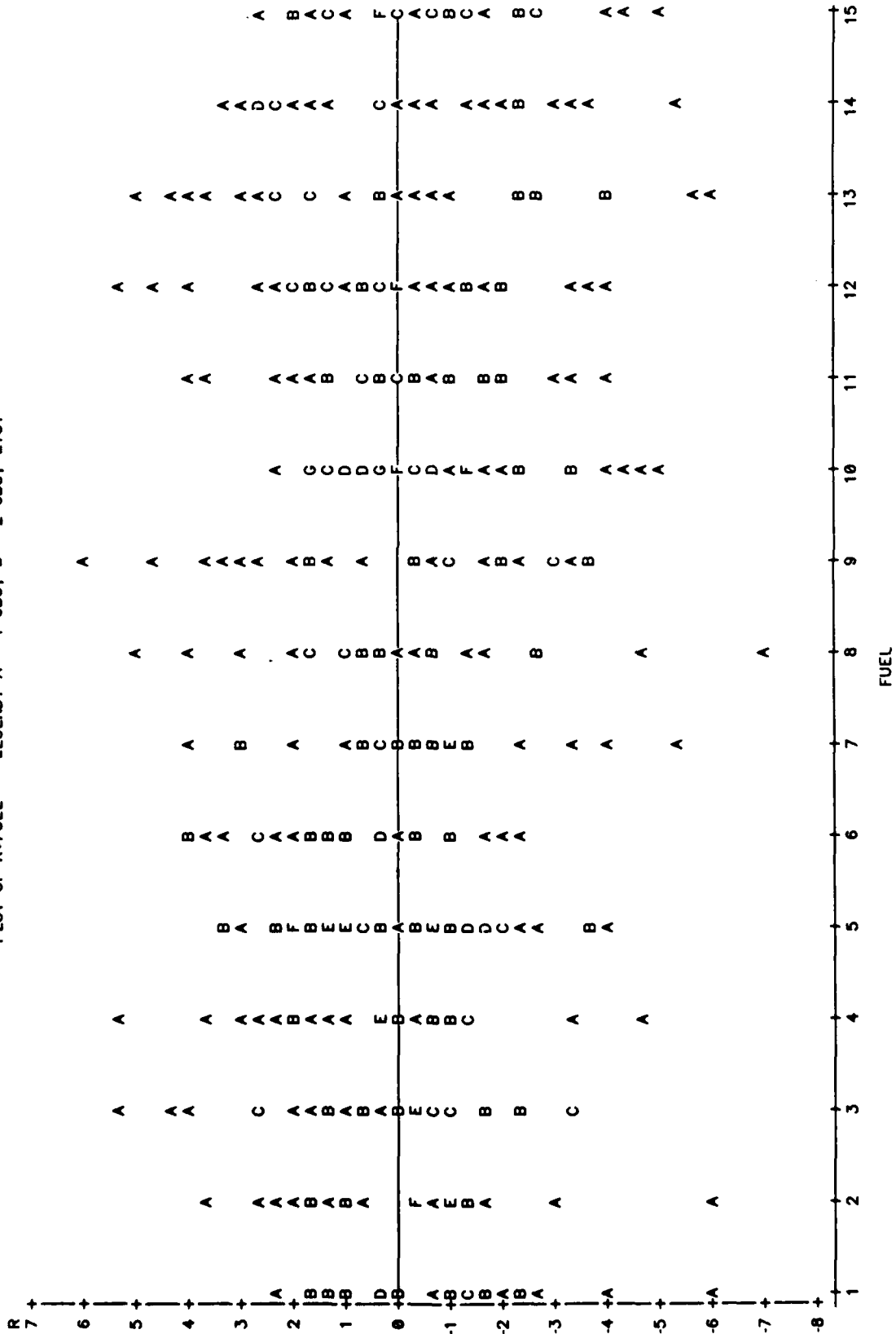
PLOT OF R+VEH LEGEND: A = 1 OBS, B = 2 OBS, ETC.



CRC 1987 Low Temperature Driveability Test
 Official Data Set
 All four runs with No-Starts are deleted
 PLOT OF R•RUN LEGEND: A = 1 OBS, B = 2 OBS, ETC.

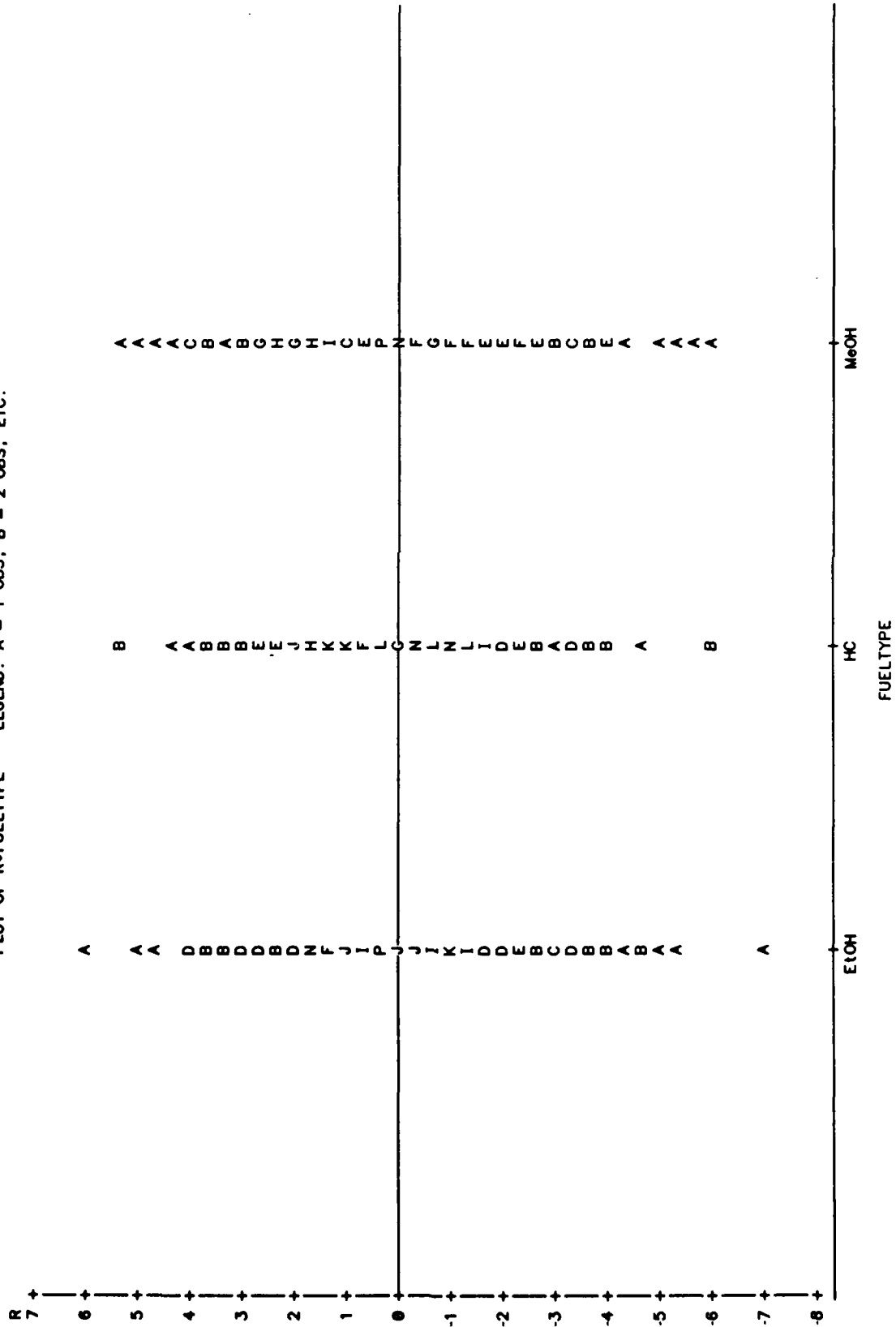


CRC 1987 Low Temperature Driveability Test
 Official Data Set
 All four runs with No-Starts are deleted
 PLOT OF R-FUEL LEGEND: A = 1 OBS, B = 2 OBS, ETC.



CRC 1987 Low Temperature Drivability Test
Official Data Set
All four runs with No-Starts are deleted

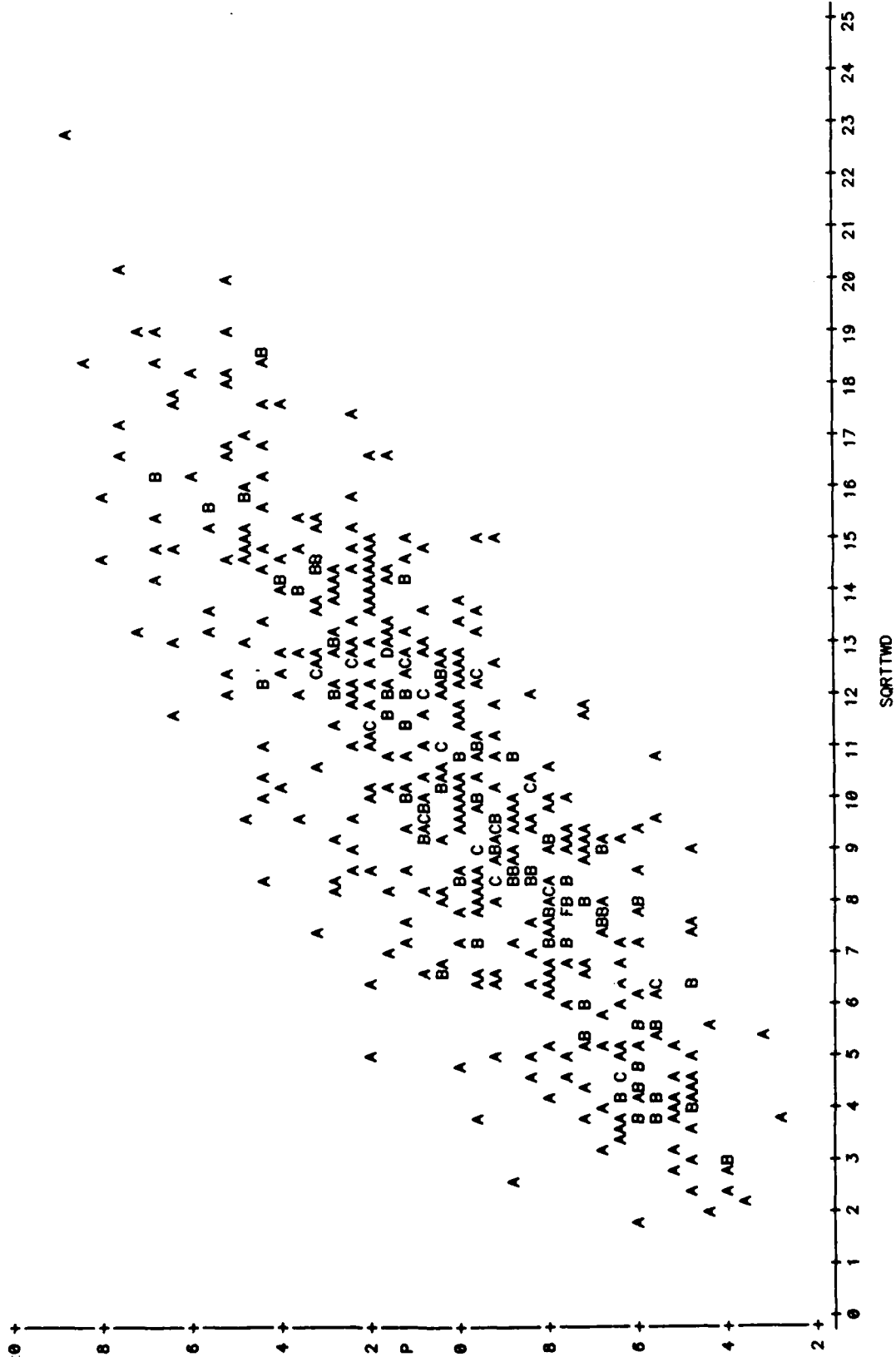
PLOT OF R•FUELTYPE LEGEND: A = 1 OBS, B = 2 OBS, ETC.



CRC 1987 Low Temperature Driveability Test
Official Data Set

All four runs with No-Starts are deleted

PLOT OF P-SORTTWO LEGEND: A = 1 OBS, B = 2 OBS, ETC.



The following runs were deleted from this model

OBS	PRGM_YR	VEH	FUEL	RUN	RATER	RUNTEMP	CTWD	HTWD	SCRTTWD	LOGITWD	SYS	TEMP	FUELTYPE	VOL	T10	T50	T90	RVP
1	1987	51	3	3	S	-5	530	16	23.0217	6.27476	PFI	low	HC	3.8_13	144	228	364	9.0
2	1987	53	8	2	U	0	530	3	23.0217	6.27476	PFI	low	EtOH	3.8_13	139	228	364	8.7
3	1987	54	8	2	R	0	530	0	23.0217	6.27476	PFI	low	EtOH	3.8_13	139	228	364	8.7
4	1987	63	8	2	S	0	530	0	23.0217	6.27476	carb	low	EtOH	3.8_13	139	228	364	8.7

```
10 REM This program takes coefficients from the GLM output of the model
20 REM sqrtctwd=fueltype sys sys*fueltype veh(sys) rater t10 t50 t90
30 REM      runtemp runtemp*fueltype
40 REM and gives the equation for predicting sqrtctwd from t10, t50, and t90
50 REM (optionally runtemp also) for each system and fueltype.
60 REM
70 REM set rtinc = 1 if you want runtemp in the prediction equation, or
80 REM      rtinc = 0 if you want the equation to predict at the avg runtemp
90 OPEN "b:report" FOR OUTPUT AS #1
100 PRINT#1, " "
110 RTINC=0
120 REM
130 REM Change the print stmts below to print what you want at the output's top
140 PRINT#1, " Coefficients for the 1986 CRC Program"
150 PRINT#1, " Three data points with high residuals were deleted"
160 PRINT#1, " "
170 PRINT#1, " "
180 REM Change the coefficients below to their appropriate values
190 T10=4.304272E-02
200 T50=.04546058
210 T90=1.366806E-02
220 RUNTEMP= -1.993824E-02
230 RTET= 8.009633E-02      :REM runtemp for ethanol
240 RTHC= .16728564#       :REM runtemp for hydrocarbon
250 RT(1)=RUNTEMP+RTET : RT(4)=RT(1) : RT(7)=RT(1)
260 RT(2)=RUNTEMP+RTHC : RT(5)=RT(2) : RT(8)=RT(2)
270 RT(3)=RUNTEMP : RT(6)=RUNTEMP : RT(9)=RUNTEMP
280 REM Change the LSMEANS below to their appropriate values
290 LSM(1)= 8.07752834#    :REM carb et
300 LSM(2)= 7.04023151#    :REM carb hc
310 LSM(3)= 9.23808485#    :REM carb me
320 LSM(4)=4.55892321#    :REM pfi et
330 LSM(5)=3.66517863#    :REM pfi hc
340 LSM(6)=5.25276467#    :REM pfi me
350 LSM(7)=6.27123533#    :REM tbi et
360 LSM(8)=4.93536955#    :REM tbi hc
370 LSM(9)=6.96997968#    :REM tbi me
380 REM Change the means of the quantitative factors below
390 MEANT10=126.865
400 MEANT50=214.124
410 MEANT90=342.202
420 MEANRT=48.5021
430 FOR I=1 TO 9
440   IF I=1 THEN PRINT#1, "carb et-----"
450   IF I=2 THEN PRINT#1, "carb hc-----"
460   IF I=3 THEN PRINT#1, "carb me-----"
470   IF I=4 THEN PRINT#1, "pfi et-----"
480   IF I=5 THEN PRINT#1, "pfi hc-----"
490   IF I=6 THEN PRINT#1, "pfi me-----"
500   IF I=7 THEN PRINT#1, "tbi et-----"
510   IF I=8 THEN PRINT#1, "tbi hc-----"
520   IF I=9 THEN PRINT#1, "tbi me-----"
530   INTE=LSM(I)-((T10*MEANT10)+(T50*MEANT50)+(T90*MEANT90))
540   IF RTINC=1 THEN INTE=INTE-RT(I)*MEANRT
550   PRINT#1, "      Intercept= " INTE
```

```
560 PRINT#1, "      T10=      " T10
570 PRINT#1, "      T50=      " T50
580 PRINT#1, "      T90=      " T90
590 IF RTINC=1 THEN PRINT#1, "      RUNTEMP=      " RT(I)
600 NEXT I
610 CLOSE #1
620 END
```

```

10 REM This program takes coefficients from the GLM output of the model
20 REM sqrtctwd=fueltype sys sys*fueltype veh(sys) rater t10 t50 t90
30 REM      runtemp runtemp*fueltype
40 REM and gives the equation for predicting sqrtctwd from t10, t50, and t90
50 REM (optionally runtemp also) for each system and fueltype.
60 REM
70 REM set rtinc = 1 if you want runtemp in the prediction equation, or
80 REM      rtinc = 0 if you want the equation to predict at the avg runtemp
90 OPEN "b:report" FOR APPEND AS #1
100 PRINT#1, " "
110 RTINC=0
120 REM
130 REM Change the print stmts below to print what you want at the output's top
140 PRINT#1, " Coefficients for the 1987 CRC Program"
150 PRINT#1, " All four No-Starts were Deleted"
160 PRINT#1, " "
170 PRINT#1, " "
180 REM Change the coefficients below to their appropriate values
190 T10=3.778339E-02
200 T50=4.176240E-02
210 T90=1.399633E-02
220 RUNTEMP= -3.066129E-02
230 RTET= -1.311845E-02      :REM runtemp for ethanol
240 RTHC= -3.29836E-03      :REM runtemp for hydrocarbon
250 RT(1)=RUNTEMP+RTET : RT(4)=RT(1) : RT(7)=RT(1)
260 RT(2)=RUNTEMP+RTHC : RT(5)=RT(2) : RT(8)=RT(2)
270 RT(3)=RUNTEMP : RT(6)=RUNTEMP : RT(9)=RUNTEMP
280 REM Change the LSMEANS below to their appropriate values
290 LSM(1)= 12.1662124#      :REM carb et
300 LSM(2)= 10.8621419#      :REM carb hc
310 LSM(3)= 12.2434333#      :REM carb me
320 LSM(4)= 8.5825193#       :REM pfi et
330 LSM(5)= 7.8516594#       :REM pfi hc
340 LSM(6)= 8.9024523#       :REM pfi me
350 LSM(7)= 8.9297536#       :REM tbi et
360 LSM(8)= 8.8412268#       :REM tbi hc
370 LSM(9)= 10.4363967#      :REM tbi me
380 REM Change the means of the quantitative factors below
390 MEANT10=127.332
400 MEANT50=213.954
410 MEANT90=341.761
420 MEANRT=22.9419
430 FOR I=1 TO 9
440   IF I=1 THEN PRINT#1, "carb et-----"
450   IF I=2 THEN PRINT#1, "carb hc-----"
460   IF I=3 THEN PRINT#1, "carb me-----"
470   IF I=4 THEN PRINT#1, "pfi et-----"
480   IF I=5 THEN PRINT#1, "pfi hc-----"
490   IF I=6 THEN PRINT#1, "pfi me-----"
500   IF I=7 THEN PRINT#1, "tbi et-----"
510   IF I=8 THEN PRINT#1, "tbi hc-----"
520   IF I=9 THEN PRINT#1, "tbi me-----"
530   INTE=LSM(I)-((T10*MEANT10)+(T50*MEANT50)+(T90*MEANT90))
540   IF RTINC=1 THEN INTE=INTE-RT(I)*MEANRT
550   PRINT#1, "      Intercept= " INTE

```

FILE: CRC87 BASIC

I-46

```
560 PRINT#1, "      T10=      " T10
570 PRINT#1, "      T50=      " T50
580 PRINT#1, "      T90=      " T90
590 IF RTINC=1 THEN PRINT#1, "      RUNTEMP=      " RT(I)
600 NEXT I
610 CLOSE #1
620 END
```

Coefficients for the 1986 CRC Program
Three data points with high residuals were deleted

carb et-----
Intercept= -11.79453
T10= 4.304272E-02
T50= 4.546058E-02
T90= 1.366806E-02

carb hc-----
Intercept= -12.83182
T10= 4.304272E-02
T50= 4.546058E-02
T90= 1.366806E-02

carb me-----
Intercept= -10.63397
T10= 4.304272E-02
T50= 4.546058E-02
T90= 1.366806E-02

pfi et-----
Intercept= -15.31313
T10= 4.304272E-02
T50= 4.546058E-02
T90= 1.366806E-02

pfi hc-----
Intercept= -16.20688
T10= 4.304272E-02
T50= 4.546058E-02
T90= 1.366806E-02

pfi me-----
Intercept= -14.61929
T10= 4.304272E-02
T50= 4.546058E-02
T90= 1.366806E-02

tbi et-----
Intercept= -13.60082
T10= 4.304272E-02
T50= 4.546058E-02
T90= 1.366806E-02

tbi hc-----
Intercept= -14.93668
T10= 4.304272E-02
T50= 4.546058E-02
T90= 1.366806E-02

tbi me-----
Intercept= -12.90207
T10= 4.304272E-02
T50= 4.546058E-02
T90= 1.366806E-02

Coefficients for the 1987 CRC Program
All four No-Starts were Deleted

```
carb et-----
      Intercept= -6.363455
      T10=       3.778339E-02
      T50=       .0417624
      T90=       1.399633E-02
carb hc-----
      Intercept= -7.667526
      T10=       3.778339E-02
      T50=       .0417624
      T90=       1.399633E-02
carb me-----
      Intercept= -6.286234
      T10=       3.778339E-02
      T50=       .0417624
      T90=       1.399633E-02
pfi et-----
      Intercept= -9.947148
      T10=       3.778339E-02
      T50=       .0417624
      T90=       1.399633E-02
pfi hc-----
      Intercept= -10.67801
      T10=       3.778339E-02
      T50=       .0417624
      T90=       1.399633E-02
pfi me-----
      Intercept= -9.627214
      T10=       3.778339E-02
      T50=       .0417624
      T90=       1.399633E-02
tbi et-----
      Intercept= -9.599914
      T10=       3.778339E-02
      T50=       .0417624
      T90=       1.399633E-02
tbi hc-----
      Intercept= -9.688441
      T10=       3.778339E-02
      T50=       .0417624
      T90=       1.399633E-02
tbi me-----
      Intercept= -8.09327
      T10=       3.778339E-02
      T50=       .0417624
      T90=       1.399633E-02
```

```
OPTIONS LS=132 GEN=0;
cms filedef a disk crc8687 data a;
data one;
  infile a firstobs=5;
  INPUT NUMBER PRGM_YR VEH FUEL RUN RATER$ RUNTEMP CTWD HTWD ;

  sqrttwd=sqrt(ctwd);
  logltwd=log(ctwd+1);
  drop number;
*
* CRCOFF8x SASDATA will contain the "official" data set for 198x, and
* CRC8687 SASDATA will contain the official data set for both years
* combined.
*;
data sasdata.crcoff86;
  set one;
  if prgm_yr=1986;
  if veh=1 then sys='carb';
  if veh=19 then sys='carb';
  if 21 le veh le 27 then sys='carb';
  if 2 le veh le 9 then sys='TBI ';
  if veh=20 then sys='TBI ';
  if 10 le veh le 18 then sys='PFI ';
  temp='med';
  if 1 le fuel le 5 then fueltype='HC ';
  if 6 le fuel le 10 then fueltype='EtOH';
  if 11 le fuel le 15 then fueltype='MeOH';
  if fuel=1 | fuel= 6 | fuel=11 then vol='1_6_11 ';
  if fuel=2 | fuel= 7 | fuel=12 then vol='2_7_12 ';
  if fuel=3 | fuel= 8 | fuel=13 then vol='3_8_13 ';
  if fuel=4 | fuel= 9 | fuel=14 then vol='4_9_14 ';
  if fuel=5 | fuel= 10 | fuel=15 then vol='5_10_15';
  if fuel=1 then do;
    T10=110;
    T50=202;
    T90=368;
    RVP=11.3;
  end;
  if fuel=2 then do;
    T10=143;
    T50=204;
    T90=316;
    RVP=8.7;
  end;
  if fuel=3 then do;
    T10=144;
    T50=228;
    T90=364;
    RVP=9.0;
  end;
  if fuel=4 then do;
    T10=113;
    T50=229;
    T90=317;
    RVP=11.0;
```

```
end;  
if fuel=5 then do;  
  T10=127;  
  T50=214;  
  T90=344;  
  RVP=9.4;  
end;  
if fuel=6 then do;  
  T10=112;  
  T50=194;  
  T90=364;  
  RVP=12.8;  
end;  
if fuel=7 then do;  
  T10=136;  
  T50=204;  
  T90=315;  
  rvp= 8.0;  
end;  
if fuel=8 then do;  
  T10=139;  
  T50=228;  
  T90=364;  
  RVP= 8.7;  
end;  
if fuel=9 then do;  
  T10=112;  
  T50=234;  
  T90=324;  
  rvp=13.3;  
end;  
if fuel=10 then do;  
  T10=129;  
  T50=211;  
  T90=344;  
  RVP=10.3;  
end;  
if fuel=11 then do;  
  T10=110;  
  T50=200;  
  T90=368;  
  RVP=12.1;  
end;  
if fuel=12 then do;  
  T10=142;  
  T50=197;  
  T90=310;  
  RVP= 8.5;  
end;  
if fuel=13 then do;  
  T10=143;  
  T50=230;  
  T90=370;  
  rvp= 9.2;  
end;
```

```
    if fuel=14 then do;
        T10=115;
        T50=227;
        T90=319;
        rvp=12.0;
    end;
    if fuel=15 then do;
        T10=126;
        T50=214;
        T90=342;
        RVP=10.4;
    end;

PROC SORT;
BY FUEL VEH;

proc print;

data sasdata.crcoff87;
    set one;
    if prgm_yr=1987;
    if 59 le veh le 68 then sys='carb';
    if 41 le veh le 49 then sys='TBI ';
    if 50 le veh le 58 then sys='PFI ';
    temp='low';
    *the following is the same as for 1986;
    if 1 le fuel le 5 then fueltype='HC ';
    if 6 le fuel le 10 then fueltype='EtOH';
    if 11 le fuel le 15 then fueltype='MeOH';
    if fuel=1 | fuel= 6 | fuel=11 then vol='1_6_11 ';
    if fuel=2 | fuel= 7 | fuel=12 then vol='2_7_12 ';
    if fuel=3 | fuel= 8 | fuel=13 then vol='3_8_13 ';
    if fuel=4 | fuel= 9 | fuel=14 then vol='4_9_14 ';
    if fuel=5 | fuel= 10 | fuel=15 then vol='5_10_15';
    if fuel=1 then do;
        T10=110;
        T50=20^;
        T90=368;
        RVP=11.3;
    end;
    if fuel=2 then do;
        T10=143;
        T50=204;
        T90=316;
        RVP=8.7;
    end;
    if fuel=3 then do;
        T10=144;
        T50=228;
        T90=364;
        RVP=9.0;
    end;
    if fuel=4 then do;
        T10=113;
        T50=229;
```

```
T90=317;
RVP=11.0;
end;
if fuel=5 then do;
  T10=127;
  T50=214;
  T90=344;
  RVP=9.4;
end;
if fuel=6 then do;
  T10=112;
  T50=194;
  T90=364;
  RVP=12.8;
end;
if fuel=7 then do;
  T10=136;
  T50=204;
  T90=315;
  rvp= 8.0;
end;
if fuel=8 then do;
  T10=139;
  T50=228;
  T90=364;
  RVP= 8.7;
end;
if fuel=9 then do;
  T10=112;
  T50=234;
  T90=324;
  rvp=13.3;
end;
if fuel=10 then do;
  T10=129;
  T50=211;
  T90=344;
  RVP=10.3;
end;
if fuel=11 then do;
  T10=110;
  T50=200;
  T90=368;
  RVP=12.1;
end;
if fuel=12 then do;
  T10=142;
  T50=197;
  T90=310;
  RVP= 8.5;
end;
if fuel=13 then do;
  T10=143;
  T50=230;
  T90=370;
```

FILE: CRCOFFCR SAS

```
      rvp= 9.2;
    end;
    if fuel=14 then do;
      T10=115;
      T50=227;
      T90=319;
      rvp=12.0;
    end;
    if fuel=15 then do;
      T10=126;
      T50=214;
      T90=342;
      RVP=10.4;
    end;

PROC SORT;
BY FUEL VEH;

proc print;
```

OBS	PRGM_YR	VEH	FUEL	RUN	RATER	RUNTEMP	CTWD	HTWD	SORTTWD	LOG1TWD	SYS	TEMP	FUELTYPE	VOL	T10	T50	T90	RVP
1	1986	1	1	1	R	44	7	2	2.6458	2.07944	carb	med	HC	1.6_11	110	202	368	11.3
2	1986	2	1	1	S	47	18	2	4.2426	2.94444	TBI	med	HC	1.6_11	110	202	368	11.3
3	1986	3	1	1	T	48	3	1	1.7321	1.38629	TBI	med	HC	1.6_11	110	202	368	11.3
4	1986	4	1	6	T	45	19	4	4.3589	2.99573	TBI	med	HC	1.6_11	110	202	368	11.3
5	1986	5	1	6	R	45	8	8	2.8284	2.19722	TBI	med	HC	1.6_11	110	202	368	11.3
6	1986	7	1	11	S	54	2	0	1.4142	1.09861	TBI	med	HC	1.6_11	110	202	368	11.3
7	1986	8	1	11	T	59	55	10	7.4162	4.02535	TBI	med	HC	1.6_11	110	202	368	11.3
8	1986	9	1	11	T	59	61	0	7.8102	4.12713	TBI	med	HC	1.6_11	110	202	368	11.3
9	1986	10	1	11	T	44	2	0	1.4142	1.09861	PFI	med	HC	1.6_11	110	202	368	11.3
10	1986	11	1	1	T	47	14	14	3.7417	2.70805	PFI	med	HC	1.6_11	110	202	368	11.3
11	1986	12	1	1	T	48	0	0	0.0000	0.00000	PFI	med	HC	1.6_11	110	202	368	11.3
12	1986	13	1	6	R	45	0	0	0.0000	0.00000	PFI	med	HC	1.6_11	110	202	368	11.3
13	1986	14	1	6	S	45	0	0	0.0000	0.00000	PFI	med	HC	1.6_11	110	202	368	11.3
14	1986	15	1	6	T	44	15	2	3.8730	2.77259	PFI	med	HC	1.6_11	110	202	368	11.3
15	1986	16	1	11	T	57	28	4	5.2915	3.36730	PFI	med	HC	1.6_11	110	202	368	11.3
16	1986	17	1	11	R	57	62	24	7.8740	4.14313	PFI	med	HC	1.6_11	110	202	368	11.3
17	1986	18	1	11	S	58	32	0	1.0000	0.69315	PFI	med	HC	1.6_11	110	202	368	11.3
18	1986	19	1	1	T	44	0	0	5.6569	3.49651	carb	med	HC	1.6_11	110	202	368	11.3
19	1986	20	1	1	R	47	8	0	2.8284	2.19722	TBI	med	HC	1.6_11	110	202	368	11.3
20	1986	21	1	1	S	48	48	2	6.9282	3.89182	carb	med	HC	1.6_11	110	202	368	11.3
21	1986	22	1	6	S	42	17	56	4.1231	2.89037	carb	med	HC	1.6_11	110	202	368	11.3
22	1986	23	1	6	T	44	108	20	10.3923	4.69135	carb	med	HC	1.6_11	110	202	368	11.3
23	1986	24	1	6	R	44	3	6	1.7321	1.38629	carb	med	HC	1.6_11	110	202	368	11.3
24	1986	25	1	11	R	57	4	0	2.0000	1.60944	carb	med	HC	1.6_11	110	202	368	11.3
25	1986	26	1	11	S	55	18	44	4.2426	2.94444	carb	med	HC	1.6_11	110	202	368	11.3
26	1986	27	1	11	T	58	127	13	11.2694	4.85203	carb	med	HC	1.6_11	110	202	368	11.3
27	1986	28	2	2	S	35	0	0	0.0000	0.00000	carb	med	HC	1.6_11	110	202	368	11.3
28	1986	29	3	2	T	38	10	0	3.1623	2.39790	TBI	med	HC	2.7_12	143	204	316	8.7
29	1986	30	4	2	R	42	12	1	3.4641	2.56495	TBI	med	HC	2.7_12	143	204	316	8.7
30	1986	31	5	2	R	44	21	0	0.0000	0.00000	TBI	med	HC	2.7_12	143	204	316	8.7
31	1986	32	7	2	T	53	49	2	7.0000	3.91202	TBI	med	HC	2.7_12	143	204	316	8.7
32	1986	33	8	2	R	54	18	1	4.2426	2.94444	TBI	med	HC	2.7_12	143	204	316	8.7
33	1986	34	9	2	S	54	23	0	4.7958	3.17805	TBI	med	HC	2.7_12	143	204	316	8.7
34	1986	35	10	2	T	36	27	4	5.1962	3.33220	PFI	med	HC	2.7_12	143	204	316	8.7
35	1986	36	11	2	K	40	43	0	0.0000	0.00000	PFI	med	HC	2.7_12	143	204	316	8.7
36	1986	37	12	2	S	42	6	0	6.5574	3.78419	PFI	med	HC	2.7_12	143	204	316	8.7
37	1986	38	13	2	T	44	29	0	2.4495	1.94591	PFI	med	HC	2.7_12	143	204	316	8.7
38	1986	39	14	2	T	42	5	2	5.3852	3.40120	PFI	med	HC	2.7_12	143	204	316	8.7
39	1986	40	15	2	R	46	10	4	2.2361	1.79176	PFI	med	HC	2.7_12	143	204	316	8.7
40	1986	41	16	2	R	53	19	0	3.1623	2.39790	PFI	med	HC	2.7_12	143	204	316	8.7
41	1986	42	17	2	S	53	25	1	4.3589	2.99573	PFI	med	HC	2.7_12	143	204	316	8.7
42	1986	43	18	2	T	53	25	1	5.0000	3.25810	PFI	med	HC	2.7_12	143	204	316	8.7
43	1986	44	19	2	R	36	1	8	1.0000	0.69315	carb	med	HC	2.7_12	143	204	316	8.7
44	1986	20	2	2	S	40	0	0	0.0000	0.00000	TBI	med	HC	2.7_12	143	204	316	8.7
45	1986	21	2	2	T	42	16	0	4.0000	2.83321	carb	med	HC	2.7_12	143	204	316	8.7
46	1986	22	2	2	T	41	174	20	13.1909	5.16479	carb	med	HC	2.7_12	143	204	316	8.7
47	1986	23	2	2	R	43	122	28	11.0454	4.81218	carb	med	HC	2.7_12	143	204	316	8.7
48	1986	24	2	2	R	46	10	0	3.1623	2.39790	carb	med	HC	2.7_12	143	204	316	8.7
49	1986	25	2	2	S	50	47	2	6.8557	3.87120	carb	med	HC	2.7_12	143	204	316	8.7
50	1986	26	2	2	T	53	50	12	7.0711	3.93183	carb	med	HC	2.7_12	143	204	316	8.7
51	1986	27	2	2	R	53	36	4	6.0000	3.61092	carb	med	HC	2.7_12	143	204	316	8.7
52	1986	28	3	3	T	47	24	0	3.0000	2.30259	carb	med	HC	3.8_13	144	228	364	9.0
53	1986	29	3	3	R	48	24	0	4.8990	3.21888	TBI	med	HC	3.8_13	144	228	364	9.0
54	1986	30	3	3	S	45	65	24	8.0623	4.18965	TBI	med	HC	3.8_13	144	228	364	9.0
55	1986	31	3	3	S	45	65	24	8.0623	4.18965	TBI	med	HC	3.8_13	144	228	364	9.0

SAS

OBS	PRGM_YR	VEH	FUEL	RUN	RATER	RUNTEMP	CTWD	HTWD	SHORTWD	LOG1TWD	SYS	TEMP	FUELTYPE	VOL	T10	T50	T90	RVP
56	1986	4	3	8	S	49	9	0	3.0000	2.30259	TBI	med	HC	3.8_13	144	228	364	9.0
57	1986	5	3	8	T	51	139	26	11.7898	4.94164	TBI	med	HC	3.8_13	144	228	364	9.0
58	1986	7	3	13	R	52	0	0	0.0000	0.00000	TBI	med	HC	3.8_13	144	228	364	9.0
59	1986	8	3	13	S	60	77	42	8.7750	4.35671	TBI	med	HC	3.8_13	144	228	364	9.0
60	1986	9	3	13	T	58	121	19	11.0000	4.80402	TBI	med	HC	3.8_13	144	228	364	9.0
61	1986	10	3	3	R	47	8	0	2.8284	2.19722	PFI	med	HC	3.8_13	144	228	364	9.0
62	1986	11	3	3	S	45	58	0	7.6158	4.07754	PFI	med	HC	3.8_13	144	228	364	9.0
63	1986	12	3	3	T	47	60	2	7.7460	4.11087	PFI	med	HC	3.8_13	144	228	364	9.0
64	1986	13	3	8	T	55	36	2	6.0000	3.61092	PFI	med	HC	3.8_13	144	228	364	9.0
65	1986	14	3	8	R	51	24	0	4.8593	3.21888	PFI	med	HC	3.8_13	144	228	364	9.0
66	1986	15	3	8	S	52	18	0	4.2426	2.94444	PFI	med	HC	3.8_13	144	228	364	9.0
67	1986	16	3	13	S	56	14	2	3.7417	2.70805	PFI	med	HC	3.8_13	144	228	364	9.0
68	1986	17	3	13	T	48	49	10	7.0000	3.91202	PFI	med	HC	3.8_13	144	228	364	9.0
69	1986	18	3	13	R	58	18	0	4.2426	2.94444	PFI	med	HC	3.8_13	144	228	364	9.0
70	1986	19	3	3	S	43	64	0	8.0000	4.17439	carb	med	HC	3.8_13	144	228	364	9.0
71	1986	20	3	3	T	47	24	0	4.8990	3.21888	TBI	med	HC	3.8_13	144	228	364	9.0
72	1986	21	3	3	R	47	69	0	8.3966	4.24850	carb	med	HC	3.8_13	144	228	364	9.0
73	1986	22	3	8	R	49	84	2	9.1652	4.44265	carb	med	HC	3.8_13	144	228	364	9.0
74	1986	23	3	8	S	49	133	4	11.5326	4.89784	carb	med	HC	3.8_13	144	228	364	9.0
75	1986	24	3	13	T	51	51	0	7.1414	3.95124	carb	med	HC	3.8_13	144	228	364	9.0
76	1986	25	3	13	T	48	128	8	11.3137	4.85981	carb	med	HC	3.8_13	144	228	364	9.0
77	1986	26	3	13	R	55	98	24	9.8995	4.59512	carb	med	HC	3.8_13	144	228	364	9.0
78	1986	27	3	13	S	60	99	0	9.9499	4.60517	carb	med	HC	3.8_13	144	228	364	9.0
79	1986	1	4	4	R	42	0	0	0.0000	0.00000	carb	med	HC	4.9_14	113	229	317	11.0
80	1986	2	4	4	S	44	21	0	4.5826	3.09104	TBI	med	HC	4.9_14	113	229	317	11.0
81	1986	3	4	4	R	48	27	3	5.1962	3.33220	TBI	med	HC	4.9_14	113	229	317	11.0
82	1986	4	4	9	T	53	51	3	7.1414	3.95124	TBI	med	HC	4.9_14	113	229	317	11.0
83	1986	5	4	9	R	48	36	0	6.0000	3.61092	TBI	med	HC	4.9_14	113	229	317	11.0
84	1986	6	4	14	S	52	41	61	6.4031	3.73767	TBI	med	HC	4.9_14	113	229	317	11.0
85	1986	7	4	14	S	55	71	3	8.4261	4.27667	TBI	med	HC	4.9_14	113	229	317	11.0
86	1986	8	4	14	S	56	6	0	2.4495	1.94591	TBI	med	HC	4.9_14	113	229	317	11.0
87	1986	9	4	4	S	42	0	0	0.0000	0.00000	PFI	med	HC	4.9_14	113	229	317	11.0
88	1986	10	4	4	S	48	30	14	5.4772	3.43399	PFI	med	HC	4.9_14	113	229	317	11.0
89	1986	11	4	4	R	48	0	0	0.0000	0.00000	PFI	med	HC	4.9_14	113	229	317	11.0
90	1986	12	4	4	R	53	0	0	0.0000	0.00000	PFI	med	HC	4.9_14	113	229	317	11.0
91	1986	13	4	9	T	53	0	0	0.0000	0.00000	PFI	med	HC	4.9_14	113	229	317	11.0
92	1986	14	4	9	T	53	57	3	7.5498	4.06044	PFI	med	HC	4.9_14	113	229	317	11.0
93	1986	15	4	14	S	55	24	3	4.8990	3.21888	PFI	med	HC	4.9_14	113	229	317	11.0
94	1986	16	4	14	S	55	12	6	3.4641	2.56495	PFI	med	HC	4.9_14	113	229	317	11.0
95	1986	17	4	14	S	61	10	66	3.1623	2.39790	PFI	med	HC	4.9_14	113	229	317	11.0
96	1986	18	4	4	R	46	73	4	8.5440	4.30407	carb	med	HC	4.9_14	113	229	317	11.0
97	1986	19	4	4	R	48	0	0	0.0000	0.00000	TBI	med	HC	4.9_14	113	229	317	11.0
98	1986	20	4	4	S	43	16	0	4.0000	2.83321	carb	med	HC	4.9_14	113	229	317	11.0
99	1986	21	4	9	S	47	127	44	11.2694	4.85203	carb	med	HC	4.9_14	113	229	317	11.0
100	1986	22	4	9	T	53	222	12	14.8997	5.40717	carb	med	HC	4.9_14	113	229	317	11.0
101	1986	23	4	9	T	53	25	16	5.0000	3.25810	carb	med	HC	4.9_14	113	229	317	11.0
102	1986	24	4	14	S	49	29	0	5.3852	3.40120	carb	med	HC	4.9_14	113	229	317	11.0
103	1986	25	4	14	S	52	33	10	5.7446	3.52636	carb	med	HC	4.9_14	113	229	317	11.0
104	1986	26	4	14	T	55	104	12	10.1980	4.65396	carb	med	HC	4.9_14	113	229	317	11.0
105	1986	27	4	14	S	55	17	0	4.1231	2.89037	carb	med	HC	5.10_15	127	214	344	9.4
106	1986	1	5	18	S	41	32	2	5.6569	3.49651	carb	med	HC	5.10_15	127	214	344	9.4
107	1986	2	5	5	T	37	22	1	4.6904	3.13549	TBI	med	HC	5.10_15	127	214	344	9.4
108	1986	3	5	18	R	46	6	2	2.4495	1.94591	TBI	med	HC	5.10_15	127	214	344	9.4
109	1986	4	5	5	R	41	0	0	0.0000	0.00000	TBI	med	HC	5.10_15	127	214	344	9.4
110	1986	5	5	18	S	44	127	42	11.2694	4.85203	TBI	med	HC	5.10_15	127	214	344	9.4

SAS

OBS	PRGL_YR	VEH	FUEL	RUN	RATER	RUNTEMP	CTWD	HTWD	LOG1TWD	SYS	TEMP	FUELTYPE	VOL	T10	T50	T90	RVP
111	1986	4	5	10	R	45	18	1	4.2426	2.94444	med	HC	5_10_15	127	214	344	9.4
112	1986	4	5	17	S	49	30	26	5.4772	3.43399	med	HC	5_10_15	127	214	344	9.4
113	1986	5	5	10	S	46	51	0	7.1414	3.95124	med	HC	5_10_15	127	214	344	9.4
114	1986	5	5	17	T	50	73	8	8.5440	4.30407	med	HC	5_10_15	127	214	344	9.4
115	1986	7	5	15	T	54	70	1	8.3666	4.26268	med	HC	5_10_15	127	214	344	9.4
116	1986	7	5	16	R	52	2	2	1.4142	1.09861	med	HC	5_10_15	127	214	344	9.4
117	1986	8	5	15	R	57	26	0	5.0990	3.29584	med	HC	5_10_15	127	214	344	9.4
118	1986	8	5	16	S	55	72	34	8.4853	4.29046	med	HC	5_10_15	127	214	344	9.4
119	1986	9	5	15	S	60	29	0	5.3852	3.40120	med	HC	5_10_15	127	214	344	9.4
120	1986	9	5	16	T	57	92	8	9.5917	4.53260	med	HC	5_10_15	127	214	344	9.4
121	1986	10	5	5	T	48	57	2	7.5498	4.06044	med	HC	5_10_15	127	214	344	9.4
122	1986	10	5	18	R	42	43	0	2.4495	1.94591	med	HC	5_10_15	127	214	344	9.4
123	1986	11	5	5	R	42	14	0	3.7417	2.70805	med	HC	5_10_15	127	214	344	9.4
124	1986	11	5	18	S	46	162	22	12.7279	5.09375	med	HC	5_10_15	127	214	344	9.4
125	1986	12	5	5	S	41	43	0	6.5574	3.78419	med	HC	5_10_15	127	214	344	9.4
126	1986	12	5	18	T	51	7	8	3.6458	2.07944	med	HC	5_10_15	127	214	344	9.4
127	1986	13	5	10	S	45	12	0	3.4641	2.56495	med	HC	5_10_15	127	214	344	9.4
128	1986	13	5	17	T	50	9	0	3.0000	2.30259	med	HC	5_10_15	127	214	344	9.4
129	1986	14	5	10	T	50	32	0	5.6569	3.49651	med	HC	5_10_15	127	214	344	9.4
130	1986	14	5	17	R	50	0	0	0.0000	0.00000	med	HC	5_10_15	127	214	344	9.4
131	1986	15	5	10	R	52	9	4	3.0000	2.30259	med	HC	5_10_15	127	214	344	9.4
132	1986	15	5	17	S	49	9	32	3.0000	2.30259	med	HC	5_10_15	127	214	344	9.4
133	1986	16	5	15	R	55	15	4	3.8730	2.77259	med	HC	5_10_15	127	214	344	9.4
134	1986	16	5	16	S	51	10	26	3.1623	2.39790	med	HC	5_10_15	127	214	344	9.4
135	1986	17	5	15	S	57	4	0	2.0000	1.60944	med	HC	5_10_15	127	214	344	9.4
136	1986	17	5	16	T	54	65	12	8.0623	4.18965	med	HC	5_10_15	127	214	344	9.4
137	1986	18	5	15	T	60	34	2	5.8310	3.55535	med	HC	5_10_15	127	214	344	9.4
138	1986	18	5	16	R	58	7	2	2.6458	2.07944	med	HC	5_10_15	127	214	344	9.4
139	1986	19	5	5	R	48	12	0	3.4641	2.56495	med	HC	5_10_15	127	214	344	9.4
140	1986	19	5	18	S	36	429	23	20.7123	6.06379	med	HC	5_10_15	127	214	344	9.4
141	1986	20	5	5	S	42	17	0	4.1231	2.89037	med	HC	5_10_15	127	214	344	9.4
142	1986	20	5	18	T	48	44	2	6.6332	3.80666	med	HC	5_10_15	127	214	344	9.4
143	1986	21	5	5	T	46	34	7	5.8310	3.55535	med	HC	5_10_15	127	214	344	9.4
144	1986	21	5	18	R	48	7	0	2.6458	2.07944	med	HC	5_10_15	127	214	344	9.4
145	1986	22	5	10	T	49	136	22	11.6619	4.91998	med	HC	5_10_15	127	214	344	9.4
146	1986	22	5	17	R	49	96	4	9.7900	4.57471	med	HC	5_10_15	127	214	344	9.4
147	1986	23	5	10	R	46	182	48	13.4907	5.20949	med	HC	5_10_15	127	214	344	9.4
148	1986	23	5	17	S	52	247	46	15.7162	5.51343	med	HC	5_10_15	127	214	344	9.4
149	1986	24	5	10	S	52	36	28	6.0000	3.61092	med	HC	5_10_15	127	214	344	9.4
150	1986	24	5	17	T	50	12	13	3.4641	2.56495	med	HC	5_10_15	127	214	344	9.4
151	1986	25	5	15	S	51	11	0	3.3166	2.48491	med	HC	5_10_15	127	214	344	9.4
152	1986	25	5	16	T	53	128	3	11.3137	4.85981	med	HC	5_10_15	127	214	344	9.4
153	1986	26	5	15	T	58	71	6	8.4261	4.27667	med	HC	5_10_15	127	214	344	9.4
154	1986	26	5	16	R	54	87	18	9.3274	4.47734	med	HC	5_10_15	127	214	344	9.4
155	1986	27	5	15	R	59	42	0	6.4807	3.76120	med	HC	5_10_15	127	214	344	9.4
156	1986	27	5	16	S	53	88	24	9.3808	4.48864	med	HC	5_10_15	127	214	344	9.4
157	1986	27	5	14	S	36	18	0	4.2426	2.94444	med	HC	5_10_15	127	214	344	9.4
158	1986	2	6	14	T	39	46	1	6.7823	3.85015	med	EtOH	1_6_11	112	194	364	12.8
159	1986	3	6	14	R	45	0	0	0.0000	0.00000	med	EtOH	1_6_11	112	194	364	12.8
160	1986	4	6	5	S	44	4	0	2.0000	1.60944	med	EtOH	1_6_11	112	194	364	12.8
161	1986	5	6	5	T	50	154	17	12.4097	5.04343	med	EtOH	1_6_11	112	194	364	12.8
162	1986	7	6	9	T	57	47	4	6.8557	3.87120	med	EtOH	1_6_11	112	194	364	12.8
163	1986	8	6	9	R	53	64	2	8.0000	4.17439	med	EtOH	1_6_11	112	194	364	12.8
164	1986	9	6	9	S	53	5	0	2.2361	1.79176	med	EtOH	1_6_11	112	194	364	12.8
165	1986	10	6	14	T	38	84	8	9.1652	4.44265	med	EtOH	1_6_11	112	194	364	12.8

OBS	PRGM_YR	VEH	FUEL	RUN	RATER	RUNTEMP	CTWD	HTWD	SAS	LOGITWD	SYS	TEMP	FUELTYPE	VOL	T10	T50	T90	RVP
166	1986	11	6	14	R	41	21	0	4.5826	3.09104	PFI	med	EtOH	1.6_11	112	194	364	12.8
167	1986	12	6	14	S	41	56	0	7.4833	4.04305	PFI	med	EtOH	1.6_11	112	194	364	12.8
168	1986	13	6	5	T	51	0	0	2.6458	2.07944	PFI	med	EtOH	1.6_11	112	194	364	12.8
169	1986	14	6	5	R	50	0	0	0.0000	0.00000	PFI	med	EtOH	1.6_11	112	194	364	12.8
170	1986	15	6	5	S	50	9	0	3.0000	2.30259	PFI	med	EtOH	1.6_11	112	194	364	12.8
171	1986	16	6	9	R	53	12	4	3.4641	2.56495	PFI	med	EtOH	1.6_11	112	194	364	12.8
172	1986	17	6	9	S	52	1	0	1.0000	0.69315	PFI	med	EtOH	1.6_11	112	194	364	12.8
173	1986	18	6	9	T	58	50	4	7.0711	3.93183	PFI	med	EtOH	1.6_11	112	194	364	12.8
174	1986	19	6	14	R	37	8	0	2.8284	2.19722	carb	med	EtOH	1.6_11	112	194	364	12.8
175	1986	20	6	14	S	40	24	0	4.8990	3.21888	TBI	med	EtOH	1.6_11	112	194	364	12.8
176	1986	21	6	14	T	48	43	0	6.5574	3.78419	carb	med	EtOH	1.6_11	112	194	364	12.8
177	1986	22	6	5	R	51	42	8	6.4807	3.76120	carb	med	EtOH	1.6_11	112	194	364	12.8
178	1986	23	6	5	S	48	67	64	8.1854	4.21951	carb	med	EtOH	1.6_11	112	194	364	12.8
179	1986	24	6	5	T	51	9	0	3.0000	2.30259	carb	med	EtOH	1.6_11	112	194	364	12.8
180	1986	25	6	9	S	50	2	0	1.4142	1.09861	carb	med	EtOH	1.6_11	112	194	364	12.8
181	1986	26	6	9	T	55	108	26	10.3923	4.69135	carb	med	EtOH	1.6_11	112	194	364	12.8
182	1986	27	6	9	R	58	104	14	10.1980	4.65396	carb	med	EtOH	1.6_11	112	194	364	12.8
183	1986	1	7	15	T	38	17	1	4.1231	2.89037	carb	med	EtOH	1.6_11	112	194	364	12.8
184	1986	2	7	15	R	45	24	0	4.8990	3.21888	TBI	med	EtOH	1.6_11	112	194	364	12.8
185	1986	3	7	15	S	45	53	22	7.2801	3.98898	TBI	med	EtOH	1.6_11	112	194	364	12.8
186	1986	4	7	1	R	47	3	0	1.7321	1.38629	TBI	med	EtOH	1.6_11	112	194	364	12.8
187	1986	5	7	1	S	47	198	60	14.0712	5.29330	TBI	med	EtOH	1.6_11	112	194	364	12.8
188	1986	7	7	10	R	50	31	13	5.5678	3.46574	TBI	med	EtOH	1.6_11	112	194	364	12.8
189	1986	8	7	10	S	48	28	35	5.2915	3.56730	TBI	med	EtOH	1.6_11	112	194	364	12.8
190	1986	9	7	10	T	58	42	2	6.4807	3.76120	TBI	med	EtOH	1.6_11	112	194	364	12.8
191	1986	10	7	15	R	43	0	0	0.0000	0.00000	PFI	med	EtOH	1.6_11	112	194	364	12.8
192	1986	11	7	15	S	45	94	2	9.6954	4.55388	PFI	med	EtOH	1.6_11	112	194	364	12.8
193	1986	12	7	15	T	48	30	0	5.4772	3.43399	PFI	med	EtOH	1.6_11	112	194	364	12.8
194	1986	13	7	19	S	38	4	0	2.0000	1.60944	PFI	med	EtOH	1.6_11	112	194	364	12.8
195	1986	14	7	19	T	38	1	0	1.0000	0.69315	PFI	med	EtOH	1.6_11	112	194	364	12.8
196	1986	15	7	10	R	50	5	0	2.2361	1.79176	PFI	med	EtOH	1.6_11	112	194	364	12.8
197	1986	16	7	10	S	50	6	0	2.4495	1.94591	PFI	med	EtOH	1.6_11	112	194	364	12.8
198	1986	17	7	10	T	55	78	20	8.8318	4.36945	PFI	med	EtOH	1.6_11	112	194	364	12.8
199	1986	18	7	10	R	52	4	2	2.0000	1.60944	PFI	med	EtOH	1.6_11	112	194	364	12.8
200	1986	19	7	15	S	38	122	30	11.0454	4.81218	carb	med	EtOH	1.6_11	112	194	364	12.8
201	1986	20	7	15	T	38	9	0	3.0000	2.30259	TBI	med	EtOH	1.6_11	112	194	364	12.8
202	1986	21	7	15	R	45	24	0	4.8990	3.21888	carb	med	EtOH	1.6_11	112	194	364	12.8
203	1986	22	7	1	T	48	53	4	7.2801	3.98898	carb	med	EtOH	1.6_11	112	194	364	12.8
204	1986	23	7	22	R	45	128	52	11.3137	4.85981	carb	med	EtOH	1.6_11	112	194	364	12.8
205	1986	24	7	1	S	45	52	0	7.2111	3.97029	carb	med	EtOH	1.6_11	112	194	364	12.8
206	1986	25	7	10	T	52	68	3	8.2462	4.23411	carb	med	EtOH	1.6_11	112	194	364	12.8
207	1986	26	7	10	R	48	58	12	7.6158	4.07754	carb	med	EtOH	1.6_11	112	194	364	12.8
208	1986	27	7	10	S	52	88	33	9.3808	4.48864	carb	med	EtOH	1.6_11	112	194	364	12.8
209	1986	1	8	11	T	51	63	0	7.9373	4.15888	carb	med	EtOH	1.6_11	112	194	364	12.8
210	1986	2	8	11	T	58	59	2	7.6811	4.09434	TBI	med	EtOH	1.6_11	112	194	364	12.8
211	1986	3	8	11	R	58	40	12	6.3246	3.71357	TBI	med	EtOH	1.6_11	112	194	364	12.8
212	1986	4	8	2	S	43	4	132	2.0000	5.86079	TBI	med	EtOH	1.6_11	112	194	364	12.8
213	1986	5	8	2	T	50	350	132	18.7083	5.86079	TBI	med	EtOH	1.6_11	112	194	364	12.8
214	1986	7	8	6	T	46	24	2	4.8990	3.21888	TBI	med	EtOH	1.6_11	112	194	364	12.8
215	1986	8	8	6	R	48	125	2	11.1803	4.83628	TBI	med	EtOH	1.6_11	112	194	364	12.8
216	1986	9	8	6	S	48	107	0	10.3441	4.68213	TBI	med	EtOH	1.6_11	112	194	364	12.8
217	1986	10	8	11	T	46	96	6	9.7980	4.57471	PFI	med	EtOH	1.6_11	112	194	364	12.8
218	1986	11	8	11	R	58	66	4	8.1240	4.20469	PFI	med	EtOH	1.6_11	112	194	364	12.8
219	1986	12	8	11	S	52	119	0	10.9087	4.78749	PFI	med	EtOH	1.6_11	112	194	364	12.8
220	1986	13	8	2	T	48	3	3	1.7321	1.38629	PFI	med	EtOH	1.6_11	112	194	364	12.8

SAS

OBS	PRGM_YR	VEH	FUEL	RUN	RATER	RUNTEMP	CTWD	HTWD	SORTWD	LOGITWD	SYS	TEMP	FUELTYPE	VOL	T10	T50	T90	RVP
221	1986	14	8	2	R	48	16	0	4.0000	2.83321	PFI	med	EtOH	3.8_13	139	228	364	8.7
222	1986	15	8	2	S	45	9	3	3.0000	2.30259	PFI	med	EtOH	3.8_13	139	228	364	8.7
223	1986	16	8	6	R	46	4	2	0.0000	1.60944	PFI	med	EtOH	3.8_13	139	228	364	8.7
224	1986	17	8	6	S	47	0	0	0.0000	0.00000	PFI	med	EtOH	3.8_13	139	228	364	8.7
225	1986	18	8	6	T	54	62	3	7.8740	4.14313	PFI	med	EtOH	3.8_13	139	228	364	8.7
226	1986	19	8	11	R	51	72	6	8.4853	4.29046	carb	med	EtOH	3.8_13	139	228	364	8.7
227	1986	20	8	11	S	52	31	0	5.5678	3.46574	TBI	med	EtOH	3.8_13	139	228	364	8.7
228	1986	21	8	11	T	53	81	1	9.0000	4.40672	carb	med	EtOH	3.8_13	139	228	364	8.7
229	1986	22	8	2	R	48	55	4	7.4162	4.02535	carb	med	EtOH	3.8_13	139	228	364	8.7
230	1986	23	8	20	S	41	436	94	20.8806	6.07993	carb	med	EtOH	3.8_13	139	228	364	8.7
231	1986	24	8	2	T	50	33	0	5.7446	3.52636	carb	med	EtOH	3.8_13	139	228	364	8.7
232	1986	25	8	6	S	46	12	2	3.4641	2.56495	carb	med	EtOH	3.8_13	139	228	364	8.7
233	1986	26	8	6	T	47	144	8	12.0000	4.97673	carb	med	EtOH	3.8_13	139	228	364	8.7
234	1986	27	8	6	R	54	69	18	8.3066	4.24850	carb	med	EtOH	3.8_13	139	228	364	8.7
235	1986	1	9	12	T	36	16	1	4.0000	2.83321	carb	med	EtOH	3.8_13	139	228	364	8.7
236	1986	2	9	12	R	41	12	0	3.4641	2.56495	TBI	med	EtOH	4.9_14	112	234	324	13.3
237	1986	3	9	12	S	42	101	44	10.8499	4.62497	TBI	med	EtOH	4.9_14	112	234	324	13.3
238	1986	4	9	3	T	47	12	0	3.4641	2.56495	TBI	med	EtOH	4.9_14	112	234	324	13.3
239	1986	5	9	3	R	55	472	156	21.7256	6.15910	TBI	med	EtOH	4.9_14	112	234	324	13.3
240	1986	7	9	7	R	51	16	14	4.0000	2.83321	TBI	med	EtOH	4.9_14	112	234	324	13.3
241	1986	8	9	7	S	54	58	4	7.6158	4.07754	TBI	med	EtOH	4.9_14	112	234	324	13.3
242	1986	9	9	7	T	36	14	1	3.7417	2.70805	PFI	med	EtOH	4.9_14	112	234	324	13.3
243	1986	10	9	12	R	46	15	30	12.5698	5.06890	PFI	med	EtOH	4.9_14	112	234	324	13.3
244	1986	11	9	12	S	41	158	23	9.2736	4.48591	TBI	med	EtOH	4.9_14	112	234	324	13.3
245	1986	12	9	12	T	42	21	1	4.5826	3.09104	PFI	med	EtOH	4.9_14	112	234	324	13.3
246	1986	13	9	3	T	47	0	0	0.0000	0.00000	PFI	med	EtOH	4.9_14	112	234	324	13.3
247	1986	14	9	3	S	46	8	0	2.8284	2.19722	PFI	med	EtOH	4.9_14	112	234	324	13.3
248	1986	15	9	3	T	47	15	2	3.8730	2.77259	PFI	med	EtOH	4.9_14	112	234	324	13.3
249	1986	16	9	3	S	51	12	0	3.4641	2.56495	PFI	med	EtOH	4.9_14	112	234	324	13.3
250	1986	17	9	7	T	50	55	0	7.4162	4.02535	PFI	med	EtOH	4.9_14	112	234	324	13.3
251	1986	18	9	7	R	55	7	2	2.6458	2.07944	PFI	med	EtOH	4.9_14	112	234	324	13.3
252	1986	19	9	12	S	30	130	0	11.4018	4.87520	carb	med	EtOH	4.9_14	112	234	324	13.3
253	1986	20	9	12	T	40	14	1	3.7417	2.70805	TBI	med	EtOH	4.9_14	112	234	324	13.3
254	1986	21	9	12	R	42	48	0	6.9282	3.89182	carb	med	EtOH	4.9_14	112	234	324	13.3
255	1986	22	9	3	S	45	89	20	9.4340	4.49881	carb	med	EtOH	4.9_14	112	234	324	13.3
256	1986	23	9	21	T	38	180	18	13.4164	5.19850	carb	med	EtOH	4.9_14	112	234	324	13.3
257	1986	24	9	3	R	53	18	0	4.2426	2.94444	carb	med	EtOH	4.9_14	112	234	324	13.3
258	1986	25	9	7	T	51	106	3	10.2956	4.67283	carb	med	EtOH	4.9_14	112	234	324	13.3
259	1986	26	9	7	R	56	85	24	9.2195	4.45435	carb	med	EtOH	4.9_14	112	234	324	13.3
260	1986	27	9	7	S	55	54	0	7.3485	4.00733	carb	med	EtOH	4.9_14	112	234	324	13.3
261	1986	1	10	13	R	38	2	0	1.4142	1.09861	carb	med	EtOH	5.10_15	129	211	344	10.3
262	1986	2	10	16	R	41	6	0	2.4495	1.94591	carb	med	EtOH	5.10_15	129	211	344	10.3
263	1986	2	10	13	S	45	52	0	7.2111	3.97029	TBI	med	EtOH	5.10_15	129	211	344	10.3
264	1986	3	10	16	S	40	65	0	8.0623	4.18965	TBI	med	EtOH	5.10_15	129	211	344	10.3
265	1986	3	10	13	T	44	46	1	6.7823	3.85015	TBI	med	EtOH	5.10_15	129	211	344	10.3
266	1986	3	10	16	T	40	47	8	6.8557	3.87120	TBI	med	EtOH	5.10_15	129	211	344	10.3
267	1986	4	10	4	R	48	0	0	0.0000	0.00000	TBI	med	EtOH	5.10_15	129	211	344	10.3
268	1986	4	10	18	T	51	32	8	5.6569	3.49651	TBI	med	EtOH	5.10_15	129	211	344	10.3
269	1986	5	10	4	S	43	20	0	4.4721	3.04452	TBI	med	EtOH	5.10_15	129	211	344	10.3
270	1986	5	10	18	R	54	82	32	9.0554	4.41884	TBI	med	EtOH	5.10_15	129	211	344	10.3
271	1986	7	10	8	S	52	7	0	2.6458	2.07944	TBI	med	EtOH	5.10_15	129	211	344	10.3
272	1986	7	10	17	S	56	12	29	3.4641	2.56495	TBI	med	EtOH	5.10_15	129	211	344	10.3
273	1986	8	10	10	T	53	90	24	9.4868	4.51086	TBI	med	EtOH	5.10_15	129	211	344	10.3
274	1986	8	10	17	T	54	117	16	10.8167	4.77068	TBI	med	EtOH	5.10_15	129	211	344	10.3
275	1986	9	10	8	R	53	50	2	7.0711	3.93183	TBI	med	EtOH	5.10_15	129	211	344	10.3

SAS																			
OBS	PRGM_YR	VEH	FUEL	RUN	RATER	RUNTEMP	CTWD	HTWD	SORTTWD	LOGITWD	SYS	TEMP	FUELTYPE	VOL	T10	T50	T90	RVP	
276	1986	9	10	17	R	57	22	2	4.6904	3.13549	TBI	med	EtoH	5_10_15	129	211	344	10.3	
277	1986	10	10	13	S	37	10	0	3.1623	2.39790	PFI	med	EtoH	5_10_15	129	211	344	10.3	
278	1986	10	10	16	S	37	28	0	5.2915	3.36730	PFI	med	EtoH	5_10_15	129	211	344	10.3	
279	1986	11	10	13	T	41	58	2	7.6158	4.07754	PFI	med	EtoH	5_10_15	129	211	344	10.3	
280	1986	11	10	16	T	40	84	2	9.1652	4.44265	PFI	med	EtoH	5_10_15	129	211	344	10.3	
281	1986	12	10	13	R	44	0	0	0.0000	0.00000	PFI	med	EtoH	5_10_15	129	211	344	10.3	
282	1986	12	10	16	R	42	8	0	2.8284	2.19722	PFI	med	EtoH	5_10_15	129	211	344	10.3	
283	1986	13	10	4	T	49	4	0	2.0000	1.60944	PFI	med	EtoH	5_10_15	129	211	344	10.3	
284	1986	13	10	18	R	48	8	0	2.8284	2.19722	PFI	med	EtoH	5_10_15	129	211	344	10.3	
285	1986	13	10	20	S	48	152	0	12.3288	5.03044	PFI	med	EtoH	5_10_15	129	211	344	10.3	
286	1986	14	10	4	T	46	24	0	4.8990	3.21888	PFI	med	EtoH	5_10_15	129	211	344	10.3	
287	1986	14	10	18	S	48	15	12	3.8730	2.77259	PFI	med	EtoH	5_10_15	129	211	344	10.3	
288	1986	15	10	4	R	48	5	2	2.2361	1.79176	PFI	med	EtoH	5_10_15	129	211	344	10.3	
289	1986	15	10	18	T	54	70	18	8.3666	4.26268	PFI	med	EtoH	5_10_15	129	211	344	10.3	
290	1986	16	10	8	T	53	64	4	8.0000	4.17439	PFI	med	EtoH	5_10_15	129	211	344	10.3	
291	1986	16	10	17	T	52	36	4	6.0000	3.61092	PFI	med	EtoH	5_10_15	129	211	344	10.3	
292	1986	17	10	8	R	53	18	24	4.2426	2.94444	PFI	med	EtoH	5_10_15	129	211	344	10.3	
293	1986	17	10	17	R	55	8	0	2.8284	2.19722	PFI	med	EtoH	5_10_15	129	211	344	10.3	
294	1986	18	10	8	S	52	34	0	5.8310	3.55535	PFI	med	EtoH	5_10_15	129	211	344	10.3	
295	1986	18	10	17	S	58	4	30	2.0000	1.60944	PFI	med	EtoH	5_10_15	129	211	344	10.3	
296	1986	19	10	13	T	37	107	10	10.3441	4.68213	carb	med	EtoH	5_10_15	129	211	344	10.3	
297	1986	19	10	16	T	40	121	19	11.0000	4.80402	carb	med	EtoH	5_10_15	129	211	344	10.3	
298	1986	20	10	13	R	43	7	0	2.6458	2.07944	TBI	med	EtoH	5_10_15	129	211	344	10.3	
299	1986	20	10	16	R	43	4	1	2.0000	1.60944	TBI	med	EtoH	5_10_15	129	211	344	10.3	
300	1986	21	10	13	S	50	78	0	8.8318	4.36945	carb	med	EtoH	5_10_15	129	211	344	10.3	
301	1986	21	10	16	S	41	65	0	8.0623	4.18965	carb	med	EtoH	5_10_15	129	211	344	10.3	
302	1986	22	10	4	T	46	122	8	11.0454	4.81218	carb	med	EtoH	5_10_15	129	211	344	10.3	
303	1986	22	10	18	S	48	214	28	14.6287	5.37064	carb	med	EtoH	5_10_15	129	211	344	10.3	
304	1986	23	10	18	T	56	372	30	19.2873	5.92158	carb	med	EtoH	5_10_15	129	211	344	10.3	
305	1986	23	10	19	R	38	109	30	10.4403	4.70048	carb	med	EtoH	5_10_15	129	211	344	10.3	
306	1986	24	10	4	S	42	8	0	2.8284	2.19722	carb	med	EtoH	5_10_15	129	211	344	10.3	
307	1986	24	10	18	R	55	6	0	2.4495	1.94591	carb	med	EtoH	5_10_15	129	211	344	10.3	
308	1986	25	10	8	R	51	32	0	5.6569	3.49651	carb	med	EtoH	5_10_15	129	211	344	10.3	
309	1986	25	10	17	R	53	47	5	6.8557	3.87120	carb	med	EtoH	5_10_15	129	211	344	10.3	
310	1986	26	10	8	S	52	39	0	6.2450	3.68888	carb	med	EtoH	5_10_15	129	211	344	10.3	
311	1986	26	10	17	S	58	34	46	5.8310	3.55535	carb	med	EtoH	5_10_15	129	211	344	10.3	
312	1986	27	10	8	T	53	127	16	11.2694	4.85203	carb	med	EtoH	5_10_15	129	211	344	10.3	
313	1986	27	10	17	T	57	54	18	7.3485	4.00733	carb	med	EtoH	5_10_15	129	211	344	10.3	
314	1986	1	11	7	R	41	0	0	0.0000	0.00000	carb	med	MeOH	1_6_11	110	200	368	12.1	
315	1986	2	11	7	S	41	24	0	4.8990	3.21888	TBI	med	MeOH	1_6_11	110	200	368	12.1	
316	1986	3	11	7	T	42	36	2	6.0000	3.61092	TBI	med	MeOH	1_6_11	110	200	368	12.1	
317	1986	4	11	13	R	44	0	0	0.0000	0.00000	TBI	med	MeOH	1_6_11	110	200	368	12.1	
318	1986	5	11	13	S	54	47	26	6.8557	3.87120	TBI	med	MeOH	1_6_11	110	200	368	12.1	
319	1986	7	11	4	R	46	21	2	4.5826	3.09104	TBI	med	MeOH	1_6_11	110	200	368	12.1	
320	1986	8	11	4	S	42	218	0	14.7648	5.38907	TBI	med	MeOH	1_6_11	110	200	368	12.1	
321	1986	9	11	4	T	55	66	1	8.1240	4.20469	TBI	med	MeOH	1_6_11	110	200	368	12.1	
322	1986	10	11	7	S	41	43	8	6.5574	3.78419	PFI	med	MeOH	1_6_11	110	200	368	12.1	
323	1986	11	11	7	T	38	242	4	15.5563	5.49306	PFI	med	MeOH	1_6_11	110	200	368	12.1	
324	1986	12	11	7	R	42	0	0	0.0000	0.00000	PFI	med	MeOH	1_6_11	110	200	368	12.1	
325	1986	13	11	13	S	50	8	28	6.6332	3.80666	PFI	med	MeOH	1_6_11	110	200	368	12.1	
326	1986	14	11	13	T	49	14	1	3.7417	2.70805	PFI	med	MeOH	1_6_11	110	200	368	12.1	
327	1986	15	11	13	R	51	8	2	2.8284	2.19722	PFI	med	MeOH	1_6_11	110	200	368	12.1	
328	1986	16	11	4	S	43	3	0	1.7321	1.38629	PFI	med	MeOH	1_6_11	110	200	368	12.1	
329	1986	17	11	4	T	50	32	11	5.6569	3.49651	PFI	med	MeOH	1_6_11	110	200	368	12.1	
330	1986	18	11	4	R	55	6	0	2.4495	1.94591	PFI	med	MeOH	1_6_11	110	200	368	12.1	

SAS

OBS	PRGAL_YR	VEH	FUEL	RUN	RATER	RUNTEMP	CTWD	HTWD	SORTTWD	LOGITWD	SYS	TEMP	FUELTYPE	VOL	T10	T50	T90	RVP
331	1986	19	11	7	T	41	110	2	10.4881	4.70953	carb	med	MeOH	1_6_11	110	200	368	12.1
332	1986	20	11	7	R	38	0	0	0.0000	0.00000	TBI	med	MeOH	1_6_11	110	200	368	12.1
333	1986	21	11	7	S	39	65	8	8.0623	4.18965	carb	med	MeOH	1_6_11	110	200	368	12.1
334	1986	22	11	13	T	48	128	18	11.3137	4.85981	carb	med	MeOH	1_6_11	110	200	368	12.1
335	1986	23	11	13	R	47	112	30	10.5830	4.72739	carb	med	MeOH	1_6_11	110	200	368	12.1
336	1986	24	11	13	S	51	19	0	4.3589	2.99573	carb	med	MeOH	1_6_11	110	200	368	12.1
337	1986	25	11	4	T	48	164	6	12.0062	5.10595	carb	med	MeOH	1_6_11	110	200	368	12.1
338	1986	26	11	4	R	50	91	18	9.5394	4.52179	carb	med	MeOH	1_6_11	110	200	368	12.1
339	1986	27	11	4	S	45	75	0	8.6603	4.33073	carb	med	MeOH	1_6_11	110	200	368	12.1
340	1986	1	12	8	S	49	31	0	5.5678	3.46574	carb	med	MeOH	2_7_12	142	197	310	8.5
341	1986	2	12	8	T	57	56	2	7.4833	4.04305	TBI	med	MeOH	2_7_12	142	197	310	8.5
342	1986	3	12	8	R	52	24	0	4.8990	3.21888	TBI	med	MeOH	2_7_12	142	197	310	8.5
343	1986	4	12	14	S	50	9	0	3.0000	2.30259	TBI	med	MeOH	2_7_12	142	197	310	8.5
344	1986	5	12	14	T	50	154	12	12.4097	5.04343	TBI	med	MeOH	2_7_12	142	197	310	8.5
345	1986	7	12	5	S	53	4	0	2.0000	1.06944	TBI	med	MeOH	2_7_12	142	197	310	8.5
346	1986	8	12	5	T	54	81	4	9.0000	4.40672	TBI	med	MeOH	2_7_12	142	197	310	8.5
347	1986	9	12	5	R	57	85	0	9.2195	4.45435	TBI	med	MeOH	2_7_12	142	197	310	8.5
348	1986	10	12	8	T	49	102	18	10.0995	4.63473	PFI	med	MeOH	2_7_12	142	197	310	8.5
349	1986	11	12	8	R	57	29	0	5.3852	3.40120	PFI	med	MeOH	2_7_12	142	197	310	8.5
350	1986	12	12	8	S	52	80	0	8.9443	4.39445	PFI	med	MeOH	2_7_12	142	197	310	8.5
351	1986	13	12	14	T	47	5	1	2.2361	1.79176	PFI	med	MeOH	2_7_12	142	197	310	8.5
352	1986	14	12	14	R	51	0	0	0.0000	0.00000	PFI	med	MeOH	2_7_12	142	197	310	8.5
353	1986	15	12	14	S	47	16	44	4.0000	2.83321	PFI	med	MeOH	2_7_12	142	197	310	8.5
354	1986	16	12	5	T	51	22	2	4.6904	3.13549	PFI	med	MeOH	2_7_12	142	197	310	8.5
355	1986	17	12	5	R	51	0	0	0.0000	0.00000	PFI	med	MeOH	2_7_12	142	197	310	8.5
356	1986	18	12	5	S	58	3	0	1.7321	1.38629	PFI	med	MeOH	2_7_12	142	197	310	8.5
357	1986	19	12	8	R	49	12	0	3.4641	2.56495	carb	med	MeOH	2_7_12	142	197	310	8.5
358	1986	20	12	8	S	49	18	0	4.2426	2.94444	TBI	med	MeOH	2_7_12	142	197	310	8.5
359	1986	21	12	8	T	55	55	0	7.4162	4.02535	carb	med	MeOH	2_7_12	142	197	310	8.5
360	1986	22	12	14	R	51	108	14	10.3923	4.69135	carb	med	MeOH	2_7_12	142	197	310	8.5
361	1986	23	12	14	S	48	395	84	19.8746	5.98141	carb	med	MeOH	2_7_12	142	197	310	8.5
362	1986	24	12	14	T	51	107	1	10.3441	4.68213	carb	med	MeOH	2_7_12	142	197	310	8.5
363	1986	25	12	5	R	51	98	0	9.8995	4.59512	carb	med	MeOH	2_7_12	142	197	310	8.5
364	1986	26	12	5	S	57	48	0	6.9282	3.89182	carb	med	MeOH	2_7_12	142	197	310	8.5
365	1986	27	12	5	T	60	83	6	9.1104	4.43082	carb	med	MeOH	2_7_12	142	197	310	8.5
366	1986	1	13	9	T	49	27	2	5.1962	3.35220	carb	med	MeOH	3_8_13	143	230	370	9.2
367	1986	2	13	9	R	46	80	2	8.9443	4.39445	TBI	med	MeOH	3_8_13	143	230	370	9.2
368	1986	3	13	15	S	46	144	44	12.0000	4.97673	TBI	med	MeOH	3_8_13	143	230	370	9.2
369	1986	4	13	15	T	49	66	2	8.1240	4.20469	TBI	med	MeOH	3_8_13	143	230	370	9.2
370	1986	5	13	15	R	48	159	6	12.6095	5.07517	TBI	med	MeOH	3_8_13	143	230	370	9.2
371	1986	7	13	1	R	47	31	0	5.5678	3.46574	TBI	med	MeOH	3_8_13	143	230	370	9.2
372	1986	8	13	1	S	47	227	8	15.0665	5.42935	TBI	med	MeOH	3_8_13	143	230	370	9.2
373	1986	9	13	1	T	46	162	1	12.7279	5.09375	TBI	med	MeOH	3_8_13	143	230	370	9.2
374	1986	10	13	9	R	49	37	0	6.0828	3.63759	PFI	med	MeOH	3_8_13	143	230	370	9.2
375	1986	11	13	9	S	46	149	26	12.2066	5.01064	PFI	med	MeOH	3_8_13	143	230	370	9.2
376	1986	12	13	9	T	49	156	2	12.4900	5.05625	PFI	med	MeOH	3_8_13	143	230	370	9.2
377	1986	13	13	15	R	47	23	0	4.7958	3.17805	PFI	med	MeOH	3_8_13	143	230	370	9.2
378	1986	14	13	15	S	48	52	0	7.2111	3.97029	PFI	med	MeOH	3_8_13	143	230	370	9.2
379	1986	15	13	15	T	54	59	3	7.6811	4.09434	PFI	med	MeOH	3_8_13	143	230	370	9.2
380	1986	16	13	19	S	38	94	2	9.6954	4.55388	PFI	med	MeOH	3_8_13	143	230	370	9.2
381	1986	17	13	1	T	46	127	1	11.2694	4.85203	PFI	med	MeOH	3_8_13	143	230	370	9.2
382	1986	18	13	1	R	51	6	0	2.4495	1.94591	PFI	med	MeOH	3_8_13	143	230	370	9.2
383	1986	19	13	9	S	44	159	0	12.6095	5.07517	carb	med	MeOH	3_8_13	143	230	370	9.2
384	1986	20	13	9	T	50	33	4	5.7446	3.52636	TBI	med	MeOH	3_8_13	143	230	370	9.2
385	1986	21	13	9	R	49	84	0	9.1652	4.44265	carb	med	MeOH	3_8_13	143	230	370	9.2

OBS	PRGM_YR	VEH	FUEL	RUN	RATER	RUNTEMP	CTWD	HTWD	SQRTWTD	LOG1TWD	SYS	TEMP	FUELTYPE	VOL	T10	T50	T90	RVP
386	1986	22	13	15	S	47	150	30	12.2474	5.01728	carb	med	MeOH	3_8_13	143	230	370	9.2
387	1986	23	13	15	T	50	384	34	19.5959	5.95324	carb	med	MeOH	3_8_13	143	230	370	9.2
388	1986	24	13	15	R	51	85	28	9.2195	4.45435	carb	med	MeOH	3_8_13	143	230	370	9.2
389	1986	25	13	1	T	45	159	24	12.6095	5.07517	carb	med	MeOH	3_8_13	143	230	370	9.2
390	1986	26	13	1	R	53	39	1	6.2450	3.68888	carb	med	MeOH	3_8_13	143	230	370	9.2
391	1986	27	13	1	S	47	36	0	6.0000	3.61092	carb	med	MeOH	3_8_13	143	230	370	9.2
392	1986	1	14	10	R	42	0	0	0.0000	0.00000	carb	med	MeOH	4_9_14	115	227	319	12.0
393	1986	2	14	10	S	43	84	0	9.1652	4.44265	TBI	med	MeOH	4_9_14	115	227	319	12.0
394	1986	3	14	10	T	54	23	3	4.7958	3.17805	TBI	med	MeOH	4_9_14	115	227	319	12.0
395	1986	4	14	11	S	52	28	0	5.2915	3.36730	TBI	med	MeOH	4_9_14	115	227	319	12.0
396	1986	5	14	11	T	57	183	24	13.5277	5.21494	TBI	med	MeOH	4_9_14	115	227	319	12.0
397	1986	7	14	2	S	45	39	0	6.2450	3.68888	TBI	med	MeOH	4_9_14	115	227	319	12.0
398	1986	8	14	2	T	51	56	80	7.4833	4.04305	TBI	med	MeOH	4_9_14	115	227	319	12.0
399	1986	9	14	2	R	50	24	1	4.8990	3.21888	TBI	med	MeOH	4_9_14	115	227	319	12.0
400	1986	10	14	10	S	42	54	33	7.3485	4.00733	PFI	med	MeOH	4_9_14	115	227	319	12.0
401	1986	11	14	10	T	56	120	8	10.9545	4.79579	PFI	med	MeOH	4_9_14	115	227	319	12.0
402	1986	12	14	10	R	44	0	0	0.0000	0.00000	PFI	med	MeOH	4_9_14	115	227	319	12.0
403	1986	13	14	11	T	56	16	2	4.0000	2.83321	PFI	med	MeOH	4_9_14	115	227	319	12.0
404	1986	14	14	11	R	57	24	0	4.8990	3.21888	PFI	med	MeOH	4_9_14	115	227	319	12.0
405	1986	15	14	11	S	54	6	46	2.4495	1.94591	PFI	med	MeOH	4_9_14	115	227	319	12.0
406	1986	16	14	2	T	50	20	4	4.4721	3.04452	PFI	med	MeOH	4_9_14	115	227	319	12.0
407	1986	17	14	2	S	50	0	6	0.0000	0.00000	PFI	med	MeOH	4_9_14	115	227	319	12.0
408	1986	18	14	2	R	51	27	0	5.1962	3.33220	PFI	med	MeOH	4_9_14	115	227	319	12.0
409	1986	19	14	10	T	55	134	1	11.5758	4.90527	carb	med	MeOH	4_9_14	115	227	319	12.0
410	1986	20	14	10	R	56	4	0	2.0000	1.60944	TBI	med	MeOH	4_9_14	115	227	319	12.0
411	1986	21	14	10	S	44	88	0	9.3088	4.48864	carb	med	MeOH	4_9_14	115	227	319	12.0
412	1986	22	14	11	R	56	86	15	9.2736	4.46591	carb	med	MeOH	4_9_14	115	227	319	12.0
413	1986	23	14	11	S	52	355	64	18.8414	5.87493	carb	med	MeOH	4_9_14	115	227	319	12.0
414	1986	24	14	11	T	56	72	12	8.4853	4.29046	carb	med	MeOH	4_9_14	115	227	319	12.0
415	1986	25	14	2	R	55	66	0	8.1240	4.20469	carb	med	MeOH	4_9_14	115	227	319	12.0
416	1986	26	14	2	S	51	47	0	6.8557	3.87120	carb	med	MeOH	4_9_14	115	227	319	12.0
417	1986	27	14	2	T	51	69	10	8.3066	4.24850	carb	med	MeOH	4_9_14	115	227	319	12.0
418	1986	1	15	6	T	37	10	0	3.1623	2.39790	carb	med	MeOH	5_10_15	126	214	342	10.4
419	1986	1	15	17	S	37	58	14	7.6158	4.07754	carb	med	MeOH	5_10_15	126	214	342	10.4
420	1986	2	15	6	R	41	36	0	6.0000	3.61092	TBI	med	MeOH	5_10_15	126	214	342	10.4
421	1986	2	15	17	T	43	83	2	9.1104	4.43082	TBI	med	MeOH	5_10_15	126	214	342	10.4
422	1986	3	15	6	S	44	46	32	6.7823	3.85015	TBI	med	MeOH	5_10_15	126	214	342	10.4
423	1986	3	15	17	R	49	29	0	5.3852	3.40120	TBI	med	MeOH	5_10_15	126	214	342	10.4
424	1986	4	15	12	T	44	45	3	6.7082	3.82864	TBI	med	MeOH	5_10_15	126	214	342	10.4
425	1986	4	15	16	R	46	2	0	1.4142	1.09861	TBI	med	MeOH	5_10_15	126	214	342	10.4
426	1986	5	15	12	R	51	140	4	11.8322	4.94876	TBI	med	MeOH	5_10_15	126	214	342	10.4
427	1986	5	15	16	S	45	89	30	9.4340	4.49981	TBI	med	MeOH	5_10_15	126	214	342	10.4
428	1986	7	15	3	T	47	6	0	2.4495	1.94591	TBI	med	MeOH	5_10_15	126	214	342	10.4
429	1986	7	15	18	T	56	75	10	8.6603	4.33073	TBI	med	MeOH	5_10_15	126	214	342	10.4
430	1986	8	15	3	R	49	60	12	7.7460	4.11087	TBI	med	MeOH	5_10_15	126	214	342	10.4
431	1986	8	15	18	R	57	24	8	4.8990	3.21888	TBI	med	MeOH	5_10_15	126	214	342	10.4
432	1986	9	15	3	S	49	12	0	3.4641	2.56495	TBI	med	MeOH	5_10_15	126	214	342	10.4
433	1986	9	15	18	S	57	41	0	6.4031	3.73767	TBI	med	MeOH	5_10_15	126	214	342	10.4
434	1986	10	15	6	R	37	0	0	0.0000	0.00000	PFI	med	MeOH	5_10_15	126	214	342	10.4
435	1986	10	15	17	T	39	66	24	8.1240	4.20469	PFI	med	MeOH	5_10_15	126	214	342	10.4
436	1986	11	15	6	S	41	111	0	10.5357	4.71850	PFI	med	MeOH	5_10_15	126	214	342	10.4
437	1986	11	15	17	R	42	54	4	7.3485	4.00733	PFI	med	MeOH	5_10_15	126	214	342	10.4
438	1986	12	15	6	T	41	56	1	7.4833	4.04305	PFI	med	MeOH	5_10_15	126	214	342	10.4
439	1986	12	15	17	S	44	59	26	7.6811	4.09434	PFI	med	MeOH	5_10_15	126	214	342	10.4
440	1986	13	15	12	R	44	2	0	1.4142	1.09861	PFI	med	MeOH	5_10_15	126	214	342	10.4

14:00 MONDAY, FEBRUARY 27, 1989

SAS

OBS	PRGM_YR	VEH	FUEL	RUN	RATER	RUNTEMP	CTWD	HTWD	SQRTWTD	LOGTWD	SYS	TEMP	FUELTYPE	VOL	T10	T50	T90	RVP
441	1986	13	15	16	S	45	45	12	6.7082	3.82864	PFI	med	MeOH	5_10_15	126	214	342	10.4
442	1986	14	15	12	S	51	0	0	0.0000	0.00000	PFI	med	MeOH	5_10_15	126	214	342	10.4
443	1986	14	15	16	S	51	26	0	5.0990	3.29584	PFI	med	MeOH	5_10_15	126	214	342	10.4
444	1986	15	15	12	T	53	38	2	6.1644	3.66356	PFI	med	MeOH	5_10_15	126	214	342	10.4
445	1986	15	15	16	R	51	17	3	4.1231	2.89037	PFI	med	MeOH	5_10_15	126	214	342	10.4
446	1986	16	15	3	R	47	8	2	2.8284	2.19722	PFI	med	MeOH	5_10_15	126	214	342	10.4
447	1986	16	15	18	R	60	15	3	3.8730	2.77259	PFI	med	MeOH	5_10_15	126	214	342	10.4
448	1986	17	15	3	S	47	0	0	0.0000	0.00000	PFI	med	MeOH	5_10_15	126	214	342	10.4
449	1986	17	15	18	S	53	18	16	4.2426	2.94444	PFI	med	MeOH	5_10_15	126	214	342	10.4
450	1986	18	15	3	T	50	27	0	5.1962	3.33220	PFI	med	MeOH	5_10_15	126	214	342	10.4
451	1986	18	15	18	T	60	38	4	6.1644	3.66356	PFI	med	MeOH	5_10_15	126	214	342	10.4
452	1986	19	15	6	S	37	70	26	8.3666	4.28268	carb	med	MeOH	5_10_15	126	214	342	10.4
453	1986	19	15	17	R	40	76	16	8.7178	4.34381	carb	med	MeOH	5_10_15	126	214	342	10.4
454	1986	20	15	6	T	40	17	2	4.1231	2.89037	TBI	med	MeOH	5_10_15	126	214	342	10.4
455	1986	20	15	17	S	44	55	18	7.4162	4.02535	TBI	med	MeOH	5_10_15	126	214	342	10.4
456	1986	21	15	6	R	40	45	0	6.7082	3.82864	carb	med	MeOH	5_10_15	126	214	342	10.4
457	1986	21	15	17	T	45	54	4	7.3485	4.00733	carb	med	MeOH	5_10_15	126	214	342	10.4
458	1986	22	15	12	S	41	216	38	14.6969	5.37990	carb	med	MeOH	5_10_15	126	214	342	10.4
459	1986	22	15	16	T	41	196	22	14.0000	5.28320	carb	med	MeOH	5_10_15	126	214	342	10.4
460	1986	23	15	12	T	52	283	42	16.8226	5.64897	carb	med	MeOH	5_10_15	126	214	342	10.4
461	1986	23	15	16	R	47	126	22	11.2250	4.84419	carb	med	MeOH	5_10_15	126	214	342	10.4
462	1986	24	15	12	R	53	53	0	7.2801	3.98898	carb	med	MeOH	5_10_15	126	214	342	10.4
463	1986	24	15	16	S	53	83	24	9.1104	4.43082	carb	med	MeOH	5_10_15	126	214	342	10.4
464	1986	25	15	3	S	51	33	0	5.7446	3.52636	carb	med	MeOH	5_10_15	126	214	342	10.4
465	1986	25	15	18	S	56	84	14	9.1652	4.4265	carb	med	MeOH	5_10_15	126	214	342	10.4
466	1986	26	15	3	T	47	92	0	9.5917	4.53260	carb	med	MeOH	5_10_15	126	214	342	10.4
467	1986	26	15	18	T	56	120	18	10.9545	4.79579	carb	med	MeOH	5_10_15	126	214	342	10.4
468	1986	27	15	3	R	47	72	6	8.4853	4.29046	carb	med	MeOH	5_10_15	126	214	342	10.4
469	1986	27	15	18	R	59	42	12	6.4807	3.76120	carb	med	MeOH	5_10_15	126	214	342	10.4

OBS	PRGM_YR	VEH	FUEL	RUN	RATER	RUNTEMP	CTWD	HTWD	SQRTWTD	LOGITWTD	SYS	TEMP	FUELTYP	VOL	T10	T50	T90	RVP
1	1987	41	1	1	R	28	9	2	3.0000	2.30259	TBI	low	HC	1_6_11	110	202	368	11.3
2	1987	42	1	1	S	30	92	2	9.5917	4.53260	TBI	low	HC	1_6_11	110	202	368	11.3
3	1987	43	1	1	U	34	6	2	2.4495	1.94591	TBI	low	HC	1_6_11	110	202	368	11.3
4	1987	44	1	17	T	27	61	10	7.8102	4.12713	TBI	low	HC	1_6_11	110	202	368	11.3
5	1987	45	1	17	R	27	28	4	5.2915	3.56730	TBI	low	HC	1_6_11	110	202	368	11.3
6	1987	46	1	17	S	27	158	32	12.5698	5.06890	TBI	low	HC	1_6_11	110	202	368	11.3
7	1987	47	1	11	S	29	186	44	13.6382	5.23111	TBI	low	HC	1_6_11	110	202	368	11.3
8	1987	48	1	11	T	31	91	1	9.5394	4.52179	TBI	low	HC	1_6_11	110	202	368	11.3
9	1987	49	1	11	T	24	62	3	7.8740	4.14313	TBI	low	HC	1_6_11	110	202	368	11.3
10	1987	50	1	1	S	30	43	0	6.5574	3.78419	PFI	low	HC	1_6_11	110	202	368	11.3
11	1987	51	1	1	U	30	26	0	5.0990	3.29584	PFI	low	HC	1_6_11	110	202	368	11.3
12	1987	52	1	1	R	31	4	2	2.0000	1.60944	PFI	low	HC	1_6_11	110	202	368	11.3
13	1987	53	1	17	R	27	16	4	4.0000	2.83321	PFI	low	HC	1_6_11	110	202	368	11.3
14	1987	54	1	17	S	27	163	29	12.7671	5.09987	PFI	low	HC	1_6_11	110	202	368	11.3
15	1987	55	1	17	T	26	19	11	7.3589	2.99573	PFI	low	HC	1_6_11	110	202	368	11.3
16	1987	56	1	11	T	29	62	2	7.8740	4.14313	PFI	low	HC	1_6_11	110	202	368	11.3
17	1987	57	1	11	R	29	34	8	5.8310	3.55535	PFI	low	HC	1_6_11	110	202	368	11.3
18	1987	58	1	11	S	31	94	21	9.6954	4.55388	PFI	low	HC	1_6_11	110	202	368	11.3
19	1987	59	1	1	U	29	7	1	2.6458	2.07944	carb	low	HC	1_6_11	110	202	368	11.3
20	1987	60	1	1	R	30	85	8	9.2195	4.45435	carb	low	HC	1_6_11	110	202	368	11.3
21	1987	61	1	1	S	31	184	66	13.5647	5.22036	carb	low	HC	1_6_11	110	202	368	11.3
22	1987	63	1	17	T	27	100	20	10.0000	4.61512	carb	low	HC	1_6_11	110	202	368	11.3
23	1987	64	1	17	R	26	99	2	9.9499	4.60517	carb	low	HC	1_6_11	110	202	368	11.3
24	1987	65	1	11	R	31	75	4	8.6603	4.33073	carb	low	HC	1_6_11	110	202	368	11.3
25	1987	66	1	11	S	31	146	30	12.0830	4.99043	carb	low	HC	1_6_11	110	202	368	11.3
26	1987	67	1	11	T	31	171	20	13.0767	5.14749	carb	low	HC	1_6_11	110	202	368	11.3
27	1987	68	1	11	R	31		4	2.8284	2.19722	carb	low	HC	1_6_11	110	202	368	11.3
28	1987	41	2	2	S	0	66	0	8.1240	4.20469	TBI	low	HC	2_7_12	143	204	316	8.7
29	1987	42	2	2	U	0	112	2	10.5830	4.72739	TBI	low	HC	2_7_12	143	204	316	8.7
30	1987	43	2	2	R	0	52	0	7.2111	3.97029	TBI	low	HC	2_7_12	143	204	316	8.7
31	1987	44	2	7	R	28	18	4	4.2426	2.94444	TBI	low	HC	2_7_12	143	204	316	8.7
32	1987	45	2	7	S	28	123	34	11.0905	4.82028	TBI	low	HC	2_7_12	143	204	316	8.7
33	1987	46	2	7	U	28	15	2	3.8730	2.77259	TBI	low	HC	2_7_12	143	204	316	8.7
34	1987	47	2	12	T	29	157	9	12.5300	5.06260	TBI	low	HC	2_7_12	143	204	316	8.7
35	1987	48	2	12	R	31	37	4	6.0828	3.63759	TBI	low	HC	2_7_12	143	204	316	8.7
36	1987	49	2	12	S	31	127	29	11.2694	4.85203	TBI	low	HC	2_7_12	143	204	316	8.7
37	1987	50	2	2	U	3	36	2	6.0000	3.61092	PFI	low	HC	2_7_12	143	204	316	8.7
38	1987	51	2	2	R	0	82	41	9.0554	4.41884	PFI	low	HC	2_7_12	143	204	316	8.7
39	1987	52	2	2	S	0	96	2	9.7980	4.57471	PFI	low	HC	2_7_12	143	204	316	8.7
40	1987	53	2	7	S	27	93	28	9.6437	4.54329	PFI	low	HC	2_7_12	143	204	316	8.7
41	1987	54	2	7	U	28	46	3	6.7823	3.85015	PFI	low	HC	2_7_12	143	204	316	8.7
42	1987	55	2	7	R	30	5	2	2.361	1.79176	PFI	low	HC	2_7_12	143	204	316	8.7
43	1987	56	2	12	R	29	29	4	5.3852	3.40120	PFI	low	HC	2_7_12	143	204	316	8.7
44	1987	57	2	12	S	29	208	42	14.4222	5.34233	PFI	low	HC	2_7_12	143	204	316	8.7
45	1987	58	2	12	T	27	62	2	7.8740	4.14313	PFI	low	HC	2_7_12	143	204	316	8.7
46	1987	59	2	2	R	0	174	12	13.1909	5.16479	carb	low	HC	2_7_12	143	204	316	8.7
47	1987	60	2	2	S	1	70	0	8.3666	4.26268	carb	low	HC	2_7_12	143	204	316	8.7
48	1987	61	2	2	U	0	117	0	10.8167	4.77068	carb	low	HC	2_7_12	143	204	316	8.7
49	1987	63	2	7	R	28	72	2	8.4853	4.29046	carb	low	HC	2_7_12	143	204	316	8.7
50	1987	64	2	7	S	30	314	57	17.7200	5.75257	carb	low	HC	2_7_12	143	204	316	8.7
51	1987	65	2	12	S	29	309	31	17.5784	5.73657	carb	low	HC	2_7_12	143	204	316	8.7
52	1987	66	2	12	T	31	103	3	10.1489	4.64439	carb	low	HC	2_7_12	143	204	316	8.7
53	1987	67	2	12	R	27	93	16	9.6437	4.54329	carb	low	HC	2_7_12	143	204	316	8.7
54	1987	68	2	12	S	27	69	16	8.3066	4.24850	carb	low	HC	2_7_12	143	204	316	8.7
55	1987	41	3	3	U	-8	36	1	6.0000	3.61092	TBI	low	HC	3_8_13	144	228	364	9.0

OBS	PRGM_YR	VEH	FUEL	RUN	RATER	RUNTEMP	CTWD	HTWD	SORTTWD	LOGITWD	SYS	TEMP	FUELTYPE	VOL	T10	T50	T90	RVP
56	1987	42	3	3	R	-5	222	8	14.8997	5.40717	TBI	low	HC	3.8_13	144	228	364	9
57	1987	43	3	3	S	-5	119	22	10.9087	4.78749	TBI	low	HC	3.8_13	144	228	364	9
58	1987	44	3	8	S	37	200	56	14.1421	5.30330	TBI	low	HC	3.8_13	144	228	364	9
59	1987	44	3	18	S	20	131	40	11.4455	4.88280	TBI	low	HC	3.8_13	144	228	364	9
60	1987	45	3	8	U	42	60	2	7.7460	4.11087	TBI	low	HC	3.8_13	144	228	364	9
61	1987	45	3	18	T	20	100	8	10.0000	4.61512	TBI	low	HC	3.8_13	144	228	364	9
62	1987	46	3	8	R	42	55	4	7.4162	4.02535	TBI	low	HC	3.8_13	144	228	364	9
63	1987	46	3	18	R	20	100	14	10.0000	4.61512	TBI	low	HC	3.8_13	144	228	364	9
64	1987	47	3	13	R	29	70	4	8.3666	4.26268	TBI	low	HC	3.8_13	144	228	364	9
65	1987	48	3	13	S	27	235	60	15.3297	5.46383	TBI	low	HC	3.8_13	144	228	364	9
66	1987	49	3	13	T	27	133	14	11.5326	4.89784	TBI	low	HC	3.8_13	144	228	364	9
67	1987	50	3	3	R	-8	148	2	12.1655	5.00395	PFI	low	HC	3.8_13	144	228	364	9
68	1987	51	3	3	S	-5	530	16	23.0217	6.27476	PFI	low	HC	3.8_13	144	228	364	9
69	1987	52	3	3	U	-6	64	2	8.0000	4.17439	PFI	low	HC	3.8_13	144	228	364	9
70	1987	53	3	8	U	37	46	4	6.7823	3.85015	PFI	low	HC	3.8_13	144	228	364	9
71	1987	53	3	18	T	20	106	6	10.2956	4.67283	PFI	low	HC	3.8_13	144	228	364	9
72	1987	54	3	8	R	37	81	8	9.0000	4.40672	PFI	low	HC	3.8_13	144	228	364	9
73	1987	54	3	18	R	20	73	4	8.5440	4.30407	PFI	low	HC	3.8_13	144	228	364	9
74	1987	55	3	8	S	44	154	38	12.4097	5.04343	PFI	low	HC	3.8_13	144	228	364	9
75	1987	55	3	18	S	20	119	38	10.9087	4.78749	PFI	low	HC	3.8_13	144	228	364	9
76	1987	56	3	13	S	29	304	39	17.4356	5.72031	PFI	low	HC	3.8_13	144	228	364	9
77	1987	57	3	13	T	27	68	8	8.2462	4.23411	PFI	low	HC	3.8_13	144	228	364	9
78	1987	58	3	13	R	23	15	4	3.8730	2.77259	PFI	low	HC	3.8_13	144	228	364	9
79	1987	59	3	3	S	-8	215	19	14.6629	5.37528	carb	low	HC	3.8_13	144	228	364	9
80	1987	60	3	3	U	-5	103	2	10.1489	4.64439	carb	low	HC	3.8_13	144	228	364	9
81	1987	61	3	3	S	-6	344	0	18.5472	5.84354	carb	low	HC	3.8_13	144	228	364	9
82	1987	63	3	8	S	41	250	52	15.8114	5.52545	carb	low	HC	3.8_13	144	228	364	9
83	1987	63	3	18	S	20	243	50	15.5885	5.49717	carb	low	HC	3.8_13	144	228	364	9
84	1987	64	3	8	U	44	133	2	11.5326	4.89784	carb	low	HC	3.8_13	144	228	364	9
85	1987	64	3	18	T	20	218	20	14.7648	5.38907	carb	low	HC	3.8_13	144	228	364	9
86	1987	65	3	13	T	29	162	15	12.7279	5.09375	carb	low	HC	3.8_13	144	228	364	9
87	1987	66	3	13	T	27	106	10	10.2956	4.67283	carb	low	HC	3.8_13	144	228	364	9
88	1987	67	3	13	S	26	234	66	15.2971	5.45959	carb	low	HC	3.8_13	144	228	364	9
89	1987	68	3	13	T	26	95	2	9.7468	4.56435	carb	low	HC	3.8_13	144	228	364	9
90	1987	41	4	4	R	18	17	4	4.1231	2.89037	TBI	low	HC	4.9_14	113	229	317	11
91	1987	42	4	4	S	18	154	0	12.4097	5.04343	TBI	low	HC	4.9_14	113	229	317	11
92	1987	43	4	4	U	18	23	2	4.7958	3.17805	TBI	low	HC	4.9_14	113	229	317	11
93	1987	44	4	9	U	14	59	3	7.6811	4.09434	TBI	low	HC	4.9_14	113	229	317	11
94	1987	45	4	9	R	17	42	4	6.4807	3.76120	TBI	low	HC	4.9_14	113	229	317	11
95	1987	46	4	9	S	17	128	41	11.3137	4.85981	TBI	low	HC	4.9_14	113	229	317	11
96	1987	47	4	20	S	10	213	35	14.5945	5.36598	TBI	low	HC	4.9_14	113	229	317	11
97	1987	48	4	14	T	20	188	14	13.7113	5.24175	TBI	low	HC	4.9_14	113	229	317	11
98	1987	49	4	14	S	20	64	4	8.0000	4.17439	TBI	low	HC	4.9_14	113	229	317	11
99	1987	50	4	4	S	18	50	0	7.0711	3.93183	PFI	low	HC	4.9_14	113	229	317	11
100	1987	51	4	4	U	18	117	6	10.8167	4.77068	PFI	low	HC	4.9_14	113	229	317	11
101	1987	52	4	4	R	18	28	4	5.2915	3.36730	PFI	low	HC	4.9_14	113	229	317	11
102	1987	53	4	9	R	14	25	4	5.0000	3.25810	PFI	low	HC	4.9_14	113	229	317	11
103	1987	54	4	9	S	14	232	31	15.2315	5.45104	PFI	low	HC	4.9_14	113	229	317	11
104	1987	55	4	9	U	18	14	2	3.7417	2.70805	PFI	low	HC	4.9_14	113	229	317	11
105	1987	56	4	14	T	21	69	4	8.3066	4.24850	PFI	low	HC	4.9_14	113	229	317	11
106	1987	57	4	14	R	21	64	8	8.0000	4.17439	PFI	low	HC	4.9_14	113	229	317	11
107	1987	58	4	14	S	21	126	32	11.2250	4.84419	PFI	low	HC	4.9_14	113	229	317	11
108	1987	59	4	4	U	18	98	1	9.8995	4.59512	carb	low	HC	4.9_14	113	229	317	11
109	1987	60	4	4	R	18	80	14	8.9443	4.39445	carb	low	HC	4.9_14	113	229	317	11
110	1987	61	4	4	S	18	169	20	13.0000	5.13580	carb	low	HC	4.9_14	113	229	317	11

SAS

OBS	PRGM_YR	VEH	FUEL	RUN	RATER	RUNTEMP	CTWD	HTWD	SQRTTWD	LOGITWD	SYS	TEMP	FUELTYPE	VOL	T10	T50	T90	RVP
111	1987	63	4	9	U	17	66	2	8.1240	4.20469	carb	low	HC	4.9_14	113	229	317	11.0
112	1987	64	4	9	R	18	215	1	14.6629	5.37528	carb	low	HC	4.9_14	113	229	317	11.0
113	1987	65	4	14	R	19	100	4	10.0000	4.61512	carb	low	HC	4.9_14	113	229	317	11.0
114	1987	66	4	14	S	20	171	40	13.0767	5.14749	carb	low	HC	4.9_14	113	229	317	11.0
115	1987	67	4	14	T	2	218	22	14.7648	5.38907	carb	low	HC	4.9_14	113	229	317	11.0
116	1987	68	4	14	R	2	13	20	3.6056	2.63906	carb	low	HC	4.9_14	113	229	317	11.0
117	1987	41	5	5	S	22	47	39	6.8557	3.87120	TBI	low	HC	5.10_15	127	214	344	9.4
118	1987	41	5	16	S	32	138	52	11.7473	4.93447	TBI	low	HC	5.10_15	127	214	344	9.4
119	1987	42	5	5	U	23	71	2	8.4261	4.27667	TBI	low	HC	5.10_15	127	214	344	9.4
120	1987	42	5	16	T	34	84	4	9.1652	4.44265	TBI	low	HC	5.10_15	127	214	344	9.4
121	1987	43	5	5	R	20	27	2	5.1962	3.33220	TBI	low	HC	5.10_15	127	214	344	9.4
122	1987	43	5	16	R	33	27	4	7.6158	4.07754	TBI	low	HC	5.10_15	127	214	344	9.4
123	1987	44	5	10	R	20	27	4	5.1962	3.33220	TBI	low	HC	5.10_15	127	214	344	9.4
124	1987	44	5	16	S	33	179	34	13.3791	5.19296	TBI	low	HC	5.10_15	127	214	344	9.4
125	1987	45	5	10	S	21	173	28	13.1529	5.15906	TBI	low	HC	5.10_15	127	214	344	9.4
126	1987	45	5	16	T	32	148	10	12.1655	5.00395	TBI	low	HC	5.10_15	127	214	344	9.4
127	1987	46	5	10	T	21	72	14	8.4853	4.29046	TBI	low	HC	5.10_15	127	214	344	9.4
128	1987	46	5	16	R	32	80	14	8.9443	4.39445	TBI	low	HC	5.10_15	127	214	344	9.4
129	1987	47	5	15	T	22	165	31	12.8452	5.11199	TBI	low	HC	5.10_15	127	214	344	9.4
130	1987	47	5	19	R	15	40	10	6.3246	3.71357	TBI	low	HC	5.10_15	127	214	344	9.4
131	1987	48	5	15	R	21	90	4	9.4868	4.51086	TBI	low	HC	5.10_15	127	214	344	9.4
132	1987	48	5	19	S	13	199	21	14.1067	5.29832	TBI	low	HC	5.10_15	127	214	344	9.4
133	1987	49	5	15	S	21	146	28	12.0830	4.99043	TBI	low	HC	5.10_15	127	214	344	9.4
134	1987	49	5	19	T	13	110	10	10.4881	4.70953	TBI	low	HC	5.10_15	127	214	344	9.4
135	1987	50	5	5	U	22	87	2	9.3274	4.47734	PFI	low	HC	5.10_15	127	214	344	9.4
136	1987	50	5	16	T	32	84	54	9.1652	4.44265	PFI	low	HC	5.10_15	127	214	344	9.4
137	1987	51	5	5	R	23	16	15	4.0000	2.83321	PFI	low	HC	5.10_15	127	214	344	9.4
138	1987	51	5	16	R	34	22	4	4.6904	3.13549	PFI	low	HC	5.10_15	127	214	344	9.4
139	1987	52	5	5	S	20	43	48	6.5574	3.78419	PFI	low	HC	5.10_15	127	214	344	9.4
140	1987	52	5	16	S	33	148	40	12.1655	5.00395	PFI	low	HC	5.10_15	127	214	344	9.4
141	1987	53	5	10	S	20	203	50	14.2478	5.31812	PFI	low	HC	5.10_15	127	214	344	9.4
142	1987	53	5	16	T	33	52	4	7.2111	3.97029	PFI	low	HC	5.10_15	127	214	344	9.4
143	1987	54	5	10	U	20	70	2	8.3666	4.26268	PFI	low	HC	5.10_15	127	214	344	9.4
144	1987	54	5	16	R	33	50	10	7.6158	4.07754	PFI	low	HC	5.10_15	127	214	344	9.4
145	1987	55	5	10	R	23	6	8	2.4495	1.94591	PFI	low	HC	5.10_15	127	214	344	9.4
146	1987	55	5	16	S	33	109	49	10.4403	4.70048	PFI	low	HC	5.10_15	127	214	344	9.4
147	1987	56	5	15	R	22	32	4	5.6569	3.49651	PFI	low	HC	5.10_15	127	214	344	9.4
148	1987	56	5	19	S	15	161	24	12.6886	5.08760	PFI	low	HC	5.10_15	127	214	344	9.4
149	1987	57	5	15	S	22	146	112	12.0830	4.99043	PFI	low	HC	5.10_15	127	214	344	9.4
150	1987	57	5	19	T	15	90	38	9.4868	4.51086	PFI	low	HC	5.10_15	127	214	344	9.4
151	1987	58	5	15	T	23	63	9	7.9373	4.15888	PFI	low	HC	5.10_15	127	214	344	9.4
152	1987	58	5	19	Y	14	16	4	4.0000	2.83321	PFI	low	HC	5.10_15	127	214	344	9.4
153	1987	59	5	5	R	22	142	28	11.9164	4.96284	carb	low	HC	5.10_15	127	214	344	9.4
154	1987	59	5	16	R	32	146	10	12.0830	4.99043	carb	low	HC	5.10_15	127	214	344	9.4
155	1987	60	5	5	S	23	152	60	12.3288	5.03044	carb	low	HC	5.10_15	127	214	344	9.4
156	1987	60	5	16	S	34	198	66	14.0712	5.29330	carb	low	HC	5.10_15	127	214	344	9.4
157	1987	61	5	5	U	20	91	1	9.5394	4.52179	carb	low	HC	5.10_15	127	214	344	9.4
158	1987	61	5	16	T	33	165	26	12.8452	5.11199	carb	low	HC	5.10_15	127	214	344	9.4
159	1987	63	5	10	F	21	72	3	8.4853	4.29046	carb	low	HC	5.10_15	127	214	344	9.4
160	1987	63	5	16	S	32	222	47	14.8997	5.40717	carb	low	HC	5.10_15	127	214	344	9.4
161	1987	64	5	10	S	23	361	24	19.0000	5.89164	carb	low	HC	5.10_15	127	214	344	9.4
162	1987	64	5	16	T	33	108	13	10.3923	4.69135	carb	low	HC	5.10_15	127	214	344	9.4
163	1987	65	5	15	S	23	147	28	12.1244	4.99721	carb	low	HC	5.10_15	127	214	344	9.4
164	1987	65	5	19	T	13	198	4	14.0712	5.29330	carb	low	HC	5.10_15	127	214	344	9.4
165	1987	66	5	15	T	21	121	20	11.0000	4.80402	carb	low	HC	5.10_15	127	214	344	9.4

SAS

OBS	PRGML_YR	VEH	FUEL	RUN	RATER	RUNTEMP	CTWD	HTWD	SORTTWD	LOG1TWD	SYS	TEMP	FUELTYPE	VOL	T10	T50	T90	RVP
166	1987	66	5	19	R	13	64	16	8.0000	4.17439	carb	low	HC	5.10-15	127	214	344	9.4
167	1987	67	5	15	R	23	138	40	11.7473	4.93447	carb	low	HC	5.10-15	127	214	344	9.4
168	1987	67	5	19	S	14	151	47	12.2882	5.02388	carb	low	HC	5.10-15	127	214	344	9.4
169	1987	68	5	15	S	23	115	62	10.7238	4.75359	carb	low	HC	5.10-15	127	214	344	9.4
170	1987	68	5	19	T	14	71	2	8.4261	4.27667	carb	low	HC	5.10-15	127	214	344	9.4
171	1987	41	6	14	S	22	184	29	13.5647	5.22036	TBI	low	EtOH	1.6-11	112	194	364	12.8
172	1987	42	6	14	T	20	85	3	9.2195	4.45435	TBI	low	EtOH	1.6-11	112	194	364	12.8
173	1987	43	6	14	R	19	64	10	8.0000	4.17439	TBI	low	EtOH	1.6-11	112	194	364	12.8
174	1987	44	6	5	S	19	60	43	7.7460	4.11087	TBI	low	EtOH	1.6-11	112	194	364	12.8
175	1987	45	6	5	S	22	51	3	7.1414	3.95124	TBI	low	EtOH	1.6-11	112	194	364	12.8
176	1987	46	6	5	U	22	61	2	7.8102	4.12713	TBI	low	EtOH	1.6-11	112	194	364	12.8
177	1987	47	6	9	R	18	53	4	7.2801	3.98898	TBI	low	EtOH	1.6-11	112	194	364	12.8
178	1987	48	6	9	U	22	41	4	6.4031	3.73767	TBI	low	EtOH	1.6-11	112	194	364	12.8
179	1987	49	6	9	S	22	163	42	12.7671	5.09987	TBI	low	EtOH	1.6-11	112	194	364	12.8
180	1987	50	6	14	T	22	161	4	12.6886	5.08760	PFI	low	EtOH	1.6-11	112	194	364	12.8
181	1987	51	6	14	R	20	17	56	4.1231	2.89037	PFI	low	EtOH	1.6-11	112	194	364	12.8
182	1987	52	6	14	S	19	156	38	12.4900	5.05625	PFI	low	EtOH	1.6-11	112	194	364	12.8
183	1987	53	6	5	U	19	81	4	9.0000	4.40672	PFI	low	EtOH	1.6-11	112	194	364	12.8
184	1987	54	6	5	U	19	89	2	9.4340	4.49981	PFI	low	EtOH	1.6-11	112	194	364	12.8
185	1987	55	6	5	S	22	146	16	12.0830	4.99043	PFI	low	EtOH	1.6-11	112	194	364	12.8
186	1987	56	6	9	R	18	31	4	5.5678	3.46574	PFI	low	EtOH	1.6-11	112	194	364	12.8
187	1987	57	6	9	S	18	229	264	15.1327	5.43808	PFI	low	EtOH	1.6-11	112	194	364	12.8
188	1987	58	6	9	U	24	30	2	5.4772	3.43399	PFI	low	EtOH	1.6-11	112	194	364	12.8
189	1987	59	6	14	R	22	102	36	10.0995	4.63473	carb	low	EtOH	1.6-11	112	194	364	12.8
190	1987	60	6	14	S	20	217	41	14.7309	5.38450	carb	low	EtOH	1.6-11	112	194	364	12.8
191	1987	61	6	14	T	19	224	12	14.9666	5.41610	carb	low	EtOH	1.6-11	112	194	364	12.8
192	1987	63	6	5	S	22	203	57	14.2478	5.31812	carb	low	EtOH	1.6-11	112	194	364	12.8
193	1987	64	6	5	S	22	88	0	9.3808	4.48804	carb	low	EtOH	1.6-11	112	194	364	12.8
194	1987	65	6	9	U	17	230	33	15.1658	5.44242	carb	low	EtOH	1.6-11	112	194	364	12.8
195	1987	66	6	9	U	22	65	8	8.0623	4.18985	carb	low	EtOH	1.6-11	112	194	364	12.8
196	1987	67	6	9	S	25	81	50	9.0000	4.40672	carb	low	EtOH	1.6-11	112	194	364	12.8
197	1987	68	6	9	R	25	159	116	12.6095	5.07517	carb	low	EtOH	1.6-11	112	194	364	12.8
198	1987	41	7	15	T	29	62	2	7.8740	4.14313	TBI	low	EtOH	2.7-12	136	204	315	8.0
199	1987	42	7	15	R	28	46	4	6.7823	3.85015	TBI	low	EtOH	2.7-12	136	204	315	8.0
200	1987	43	7	15	S	25	132	51	11.4891	4.89035	TBI	low	EtOH	2.7-12	136	204	315	8.0
201	1987	44	7	1	R	33	19	4	4.3589	2.99573	TBI	low	EtOH	2.7-12	136	204	315	8.0
202	1987	45	7	1	S	33	41	56	6.4031	3.73767	TBI	low	EtOH	2.7-12	136	204	315	8.0
203	1987	46	7	1	U	33	8	1	2.8284	2.19722	TBI	low	EtOH	2.7-12	136	204	315	8.0
204	1987	47	7	10	R	21	68	4	8.2462	4.23411	TBI	low	EtOH	2.7-12	136	204	315	8.0
205	1987	48	7	10	S	21	222	50	14.8997	5.40717	TBI	low	EtOH	2.7-12	136	204	315	8.0
206	1987	49	7	10	T	21	98	2	9.8995	4.59512	TBI	low	EtOH	2.7-12	136	204	315	8.0
207	1987	50	7	15	R	29	58	4	7.6158	4.07754	PFI	low	EtOH	2.7-12	136	204	315	8.0
208	1987	51	7	15	S	28	146	32	12.0830	4.99043	PFI	low	EtOH	2.7-12	136	204	315	8.0
209	1987	52	7	15	T	25	52	3	7.2111	3.97029	PFI	low	EtOH	2.7-12	136	204	315	8.0
210	1987	53	7	1	S	37	134	24	11.5758	4.90527	PFI	low	EtOH	2.7-12	136	204	315	8.0
211	1987	54	7	1	U	33	15	2	3.8730	2.77259	PFI	low	EtOH	2.7-12	136	204	315	8.0
212	1987	55	7	1	R	34	9	2	3.0000	2.30259	PFI	low	EtOH	2.7-12	136	204	315	8.0
213	1987	56	7	10	S	21	201	28	14.1774	5.30827	PFI	low	EtOH	2.7-12	136	204	315	8.0
214	1987	57	7	10	T	21	93	10	9.6437	4.54329	PFI	low	EtOH	2.7-12	136	204	315	8.0
215	1987	58	7	10	R	21	15	4	3.8730	2.77259	PFI	low	EtOH	2.7-12	136	204	315	8.0
216	1987	59	7	15	S	29	263	58	16.2173	5.57595	carb	low	EtOH	2.7-12	136	204	315	8.0
217	1987	60	7	15	T	28	158	24	12.5698	5.06890	carb	low	EtOH	2.7-12	136	204	315	8.0
218	1987	61	7	15	R	25	140	2	11.8322	4.94876	carb	low	EtOH	2.7-12	136	204	315	8.0
219	1987	63	7	1	R	33	64	2	8.0000	4.17439	carb	low	EtOH	2.7-12	136	204	315	8.0
220	1987	64	7	1	S	33	176	58	13.2665	5.17615	carb	low	EtOH	2.7-12	136	204	315	8.0

SAS

OBS	PRGM_YR	VEH	FUEL	RUN	RATER	RUNTEMP	CTWD	HTWD	SQRTTWD	LOG1TWD	SYS	TEMP	FUELTYPE	VOL	T10	T50	T90	RVP
221	1987	65	7	10	T	23	162	8	12.7279	5.09375	carb	low	EtOH	2.7_12	136	204	315	8.0
222	1987	66	7	10	R	21	96	22	9.7980	4.57471	carb	low	EtOH	2.7_12	136	204	315	8.0
223	1987	67	7	10	S	21	360	54	18.9737	5.88888	carb	low	EtOH	2.7_12	136	204	315	8.0
224	1987	68	7	10	T	21	50	15	7.0711	3.93183	carb	low	EtOH	2.7_12	136	204	315	8.0
225	1987	41	8	11	S	24	277	32	16.6433	5.62762	TBI	low	EtOH	3.8_13	139	228	364	8.7
226	1987	42	8	11	T	24	171	2	13.0767	5.14749	TBI	low	EtOH	3.8_13	139	228	364	8.7
227	1987	43	8	11	R	24	71	2	8.4261	4.27667	TBI	low	EtOH	3.8_13	139	228	364	8.7
228	1987	44	8	2	S	0	70	2	8.3666	4.26268	TBI	low	EtOH	3.8_13	139	228	364	8.7
229	1987	45	8	2	U	0	43	4	6.5574	3.78419	TBI	low	EtOH	3.8_13	139	228	364	8.7
230	1987	46	8	2	R	0	155	0	12.4499	5.04986	TBI	low	EtOH	3.8_13	139	228	364	8.7
231	1987	47	8	17	T	28	132	21	11.4891	4.89035	TBI	low	EtOH	3.8_13	139	228	364	8.7
232	1987	48	8	17	R	28	70	10	8.3666	4.26268	TBI	low	EtOH	3.8_13	139	228	364	8.7
233	1987	49	8	17	S	28	195	50	13.9642	5.27811	TBI	low	EtOH	3.8_13	139	228	364	8.7
234	1987	50	8	11	T	24	105	6	10.2470	4.66344	PFI	low	EtOH	3.8_13	139	228	364	8.7
235	1987	51	8	11	R	24	87	14	9.3274	4.47734	PFI	low	EtOH	3.8_13	139	228	364	8.7
236	1987	52	8	11	S	24	193	44	13.8924	5.26786	PFI	low	EtOH	3.8_13	139	228	364	8.7
237	1987	53	8	2	U	0	530	3	23.0217	6.27476	PFI	low	EtOH	3.8_13	139	228	364	8.7
238	1987	54	8	2	R	0	530	0	23.0217	6.27476	PFI	low	EtOH	3.8_13	139	228	364	8.7
239	1987	55	8	2	S	0	25	0	5.0000	3.25810	PFI	low	EtOH	3.8_13	139	228	364	8.7
240	1987	56	8	17	R	28	28	4	5.2915	3.36730	PFI	low	EtOH	3.8_13	139	228	364	8.7
241	1987	57	8	17	S	28	260	208	16.1245	5.56452	PFI	low	EtOH	3.8_13	139	228	364	8.7
242	1987	58	8	17	T	26	90	10	9.4868	4.51086	PFI	low	EtOH	3.8_13	139	228	364	8.7
243	1987	59	8	11	R	24	238	12	15.4272	5.47646	carb	low	EtOH	3.8_13	139	228	364	8.7
244	1987	60	8	11	S	24	310	62	17.6068	5.73979	carb	low	EtOH	3.8_13	139	228	364	8.7
245	1987	61	8	11	T	24	261	6	16.1555	5.56834	carb	low	EtOH	3.8_13	139	228	364	8.7
246	1987	63	8	2	S	0	530	0	23.0217	6.27476	carb	low	EtOH	3.8_13	139	228	364	8.7
247	1987	64	8	2	U	1	349	28	18.6815	5.85793	carb	low	EtOH	3.8_13	139	228	364	8.7
248	1987	65	8	17	S	26	342	28	18.4932	5.83773	carb	low	EtOH	3.8_13	139	228	364	8.7
249	1987	66	8	17	T	28	168	52	12.9615	5.12990	carb	low	EtOH	3.8_13	139	228	364	8.7
250	1987	67	8	17	R	26	106	22	10.2956	4.67283	carb	low	EtOH	3.8_13	139	228	364	8.7
251	1987	68	8	17	S	26	179	36	13.3791	5.19296	carb	low	EtOH	3.8_13	139	228	364	8.7
252	1987	41	9	12	T	29	51	2	7.1414	3.95124	TBI	low	EtOH	4.9_14	112	234	324	13.3
253	1987	42	9	12	R	31	22	4	4.6904	3.13549	TBI	low	EtOH	4.9_14	112	234	324	13.3
254	1987	43	9	12	S	31	166	17	12.8841	5.11799	TBI	low	EtOH	4.9_14	112	234	324	13.3
255	1987	44	9	3	U	0	39	0	6.2450	3.68888	TBI	low	EtOH	4.9_14	112	234	324	13.3
256	1987	45	9	3	R	-2	227	4	15.0665	5.42935	TBI	low	EtOH	4.9_14	112	234	324	13.3
257	1987	46	9	3	S	0	112	2	10.5830	4.72739	TBI	low	EtOH	4.9_14	112	234	324	13.3
258	1987	47	9	7	R	30	60	12	7.7460	4.11087	TBI	low	EtOH	4.9_14	112	234	324	13.3
259	1987	48	9	7	S	31	223	51	14.9332	5.41165	TBI	low	EtOH	4.9_14	112	234	324	13.3
260	1987	49	9	7	U	31	11	2	3.3166	2.48491	TBI	low	EtOH	4.9_14	112	234	324	13.3
261	1987	50	9	12	R	29	21	10	4.5826	3.09104	PFI	low	EtOH	4.9_14	112	234	324	13.3
262	1987	51	9	12	S	31	119	32	10.9087	4.78749	PFI	low	EtOH	4.9_14	112	234	324	13.3
263	1987	52	9	12	T	31	57	2	7.5498	4.06044	PFI	low	EtOH	4.9_14	112	234	324	13.3
264	1987	53	9	3	R	0	100	4	10.0000	4.61512	PFI	low	EtOH	4.9_14	112	234	324	13.3
265	1987	54	9	3	S	-6	142	0	11.9164	4.96284	PFI	low	EtOH	4.9_14	112	234	324	13.3
266	1987	55	9	3	U	2	16	2	4.0000	2.83321	PFI	low	EtOH	4.9_14	112	234	324	13.3
267	1987	56	9	3	S	30	227	59	15.0665	5.42935	PFI	low	EtOH	4.9_14	112	234	324	13.3
268	1987	57	9	7	U	30	139	6	11.7898	4.94164	PFI	low	EtOH	4.9_14	112	234	324	13.3
269	1987	58	9	7	R	31	10	10	3.1623	2.39790	PFI	low	EtOH	4.9_14	112	234	324	13.3
270	1987	59	9	12	S	29	220	52	14.8324	5.39816	carb	low	EtOH	4.9_14	112	234	324	13.3
271	1987	60	9	12	T	31	210	20	14.4914	5.35186	carb	low	EtOH	4.9_14	112	234	324	13.3
272	1987	61	9	12	R	31	151	7	12.2882	5.02388	carb	low	EtOH	4.9_14	112	234	324	13.3
273	1987	63	9	3	U	-2	67	1	8.1854	4.21951	carb	low	EtOH	4.9_14	112	234	324	13.3
274	1987	64	9	3	R	2	308	9	17.5499	5.73334	carb	low	EtOH	4.9_14	112	234	324	13.3
275	1987	65	9	7	U	30	43	2	6.5574	3.78419	carb	low	EtOH	4.9_14	112	234	324	13.3

OBS	PRGAL_YR	VEH	FUEL	RUN	RATER	RUNTEMP	CTWD	HTWD	SQRTTWD	LOG1TWD	SYS	TEMP	FUELTYPE	VOL	T10	T50	T90	RVP
276	1987	66	9	7	R	31	17	16	4.1231	2.89037	carb	low	EtOH	4.9-14	112	234	324	13.3
277	1987	67	9	7	S	31	279	53	16.7033	5.63479	carb	low	EtOH	4.9-14	112	234	324	13.3
278	1987	68	9	7	U	31	56	2	7.4833	4.04305	carb	low	EtOH	4.9-14	112	234	324	13.3
279	1987	41	10	13	R	29	42	4	6.4807	3.76120	TBI	low	EtOH	5-10-15	129	211	344	10.3
280	1987	41	10	13	R	23	42	4	6.4807	3.76120	TBI	low	EtOH	5-10-15	129	211	344	10.3
281	1987	42	10	13	S	28	205	60	14.3178	5.32788	TBI	low	EtOH	5-10-15	129	211	344	10.3
282	1987	42	10	13	S	23	186	27	13.6382	5.23111	TBI	low	EtOH	5-10-15	129	211	344	10.3
283	1987	43	10	13	T	29	74	7	8.6023	4.31749	TBI	low	EtOH	5-10-15	129	211	344	10.3
284	1987	43	10	19	T	23	108	2	10.3923	4.69135	TBI	low	EtOH	5-10-15	129	211	344	10.3
285	1987	44	10	4	R	21	20	4	4.4721	3.04452	TBI	low	EtOH	5-10-15	129	211	344	10.3
286	1987	45	10	4	S	23	68	26	8.2462	4.23411	TBI	low	EtOH	5-10-15	129	211	344	10.3
287	1987	46	10	4	U	23	3	2	1.7321	1.38629	TBI	low	EtOH	5-10-15	129	211	344	10.3
288	1987	47	10	8	S	32	194	92	13.9284	5.24175	TBI	low	EtOH	5-10-15	129	211	344	10.3
289	1987	47	10	16	S	32	188	64	13.7113	5.24175	TBI	low	EtOH	5-10-15	129	211	344	10.3
290	1987	47	10	18	S	19	155	54	12.4499	5.04986	TBI	low	EtOH	5-10-15	129	211	344	10.3
291	1987	48	10	8	U	42	32	20	5.6569	3.49651	TBI	low	EtOH	5-10-15	129	211	344	10.3
292	1987	48	10	16	T	32	70	28	8.3666	4.26268	TBI	low	EtOH	5-10-15	129	211	344	10.3
293	1987	48	10	18	T	17	119	12	10.9087	4.78749	TBI	low	EtOH	5-10-15	129	211	344	10.3
294	1987	49	10	8	R	32	54	2	7.3485	4.00733	TBI	low	EtOH	5-10-15	129	211	344	10.3
295	1987	49	10	16	R	32	83	10	9.1104	4.43082	TBI	low	EtOH	5-10-15	129	211	344	10.3
296	1987	49	10	18	R	17	83	16	9.1104	4.43082	TBI	low	EtOH	5-10-15	129	211	344	10.3
297	1987	50	10	13	S	29	137	52	11.7047	4.92725	PFI	low	EtOH	5-10-15	129	211	344	10.3
298	1987	50	10	13	S	23	80	24	8.9443	4.39445	PFI	low	EtOH	5-10-15	129	211	344	10.3
299	1987	51	10	13	T	28	23	26	4.7958	3.17805	PFI	low	EtOH	5-10-15	129	211	344	10.3
300	1987	51	10	13	T	23	116	18	10.7703	4.76217	PFI	low	EtOH	5-10-15	129	211	344	10.3
301	1987	52	10	13	R	29	15	4	3.8730	2.77259	PFI	low	EtOH	5-10-15	129	211	344	10.3
302	1987	52	10	19	R	23	24	4	4.8990	3.21888	PFI	low	EtOH	5-10-15	129	211	344	10.3
303	1987	53	10	4	S	21	73	14	8.5440	4.30407	PFI	low	EtOH	5-10-15	129	211	344	10.3
304	1987	54	10	4	U	21	44	2	6.6332	3.80666	PFI	low	EtOH	5-10-15	129	211	344	10.3
305	1987	55	10	4	R	24	42	6	6.4807	3.76120	PFI	low	EtOH	5-10-15	129	211	344	10.3
306	1987	56	10	8	U	44	40	8	6.3246	3.71357	PFI	low	EtOH	5-10-15	129	211	344	10.3
307	1987	56	10	16	T	32	80	16	9.4340	4.49981	PFI	low	EtOH	5-10-15	129	211	344	10.3
308	1987	56	10	18	T	19	122	15	11.0454	4.81218	PFI	low	EtOH	5-10-15	129	211	344	10.3
309	1987	57	10	8	R	44	82	44	9.0554	4.41884	PFI	low	EtOH	5-10-15	129	211	344	10.3
310	1987	57	10	16	R	32	105	46	7.9373	4.15888	PFI	low	EtOH	5-10-15	129	211	344	10.3
311	1987	57	10	18	R	19	82	35	9.0554	4.41884	PFI	low	EtOH	5-10-15	129	211	344	10.3
312	1987	58	10	8	S	42	82	35	9.0554	4.41884	PFI	low	EtOH	5-10-15	129	211	344	10.3
313	1987	58	10	16	S	31	100	32	10.0000	4.61512	PFI	low	EtOH	5-10-15	129	211	344	10.3
314	1987	58	10	18	S	17	121	42	11.0000	4.80402	PFI	low	EtOH	5-10-15	129	211	344	10.3
315	1987	59	10	13	T	29	245	22	15.6525	5.50533	carb	low	EtOH	5-10-15	129	211	344	10.3
316	1987	59	10	13	T	23	217	40	14.7309	5.38450	carb	low	EtOH	5-10-15	129	211	344	10.3
317	1987	60	10	13	R	28	106	2	10.2956	4.67283	carb	low	EtOH	5-10-15	129	211	344	10.3
318	1987	60	10	19	R	23	43	4	6.5574	3.78419	carb	low	EtOH	5-10-15	129	211	344	10.3
319	1987	61	10	13	S	29	295	47	17.1756	5.69036	carb	low	EtOH	5-10-15	129	211	344	10.3
320	1987	61	10	18	S	23	273	29	16.5227	5.61313	carb	low	EtOH	5-10-15	129	211	344	10.3
321	1987	63	10	4	R	25	63	3	7.9373	4.15888	carb	low	EtOH	5-10-15	129	211	344	10.3
322	1987	64	10	4	S	24	250	17	15.8114	5.52545	carb	low	EtOH	5-10-15	129	211	344	10.3
323	1987	65	10	8	R	44	134	3	11.5758	4.90527	carb	low	EtOH	5-10-15	129	211	344	10.3
324	1987	65	10	16	R	33	162	4	12.7279	5.09375	carb	low	EtOH	5-10-15	129	211	344	10.3
325	1987	65	10	18	R	20	144	4	12.0000	4.97673	carb	low	EtOH	5-10-15	129	211	344	10.3
326	1987	66	10	8	S	42	150	36	12.2474	5.01728	carb	low	EtOH	5-10-15	129	211	344	10.3
327	1987	66	10	16	S	32	169	32	13.0000	5.13580	carb	low	EtOH	5-10-15	129	211	344	10.3
328	1987	66	10	18	S	17	159	48	12.6095	5.07517	carb	low	EtOH	5-10-15	129	211	344	10.3
329	1987	67	10	8	U	42	74	20	8.6023	4.31749	carb	low	EtOH	5-10-15	129	211	344	10.3
330	1987	67	10	16	T	31	145	24	12.0416	4.98361	carb	low	EtOH	5-10-15	129	211	344	10.3

SAS

OBS	PRGM_YR	VEH	FUEL	RUN	RATER	RUNTEMP	CTWD	HTWD	SQRTWTD	LOGITWTD	SYS	TEMP	FUELTYPE	VOL	T10	T50	T90	RVP
331	1987	67	10	18	T	17	145	100	12.0416	4.98361	carb	low	EtOH	5_10_15	129	211	344	10.3
332	1987	68	10	8	R	42	21	2	4.5826	3.09104	carb	low	EtOH	5_10_15	129	211	344	10.3
333	1987	68	10	16	R	31	38	4	6.1644	3.66356	carb	low	EtOH	5_10_15	129	211	344	10.3
334	1987	68	10	18	R	17	28	4	5.2915	3.36730	carb	low	EtOH	5_10_15	129	211	344	10.3
335	1987	41	11	7	R	18	18	4	4.2426	2.94444	TBI	low	MeOH	1_6_11	110	200	368	12.1
336	1987	42	11	7	S	26	200	46	14.1421	5.30330	TBI	low	MeOH	1_6_11	110	200	368	12.1
337	1987	43	11	7	U	28	21	4	4.5826	3.09104	TBI	low	MeOH	1_6_11	110	200	368	12.1
338	1987	44	11	13	S	28	22	4	4.6904	3.13549	TBI	low	MeOH	1_6_11	110	200	368	12.1
339	1987	45	11	13	S	27	190	32	13.7840	5.25227	TBI	low	MeOH	1_6_11	110	200	368	12.1
340	1987	46	11	13	T	29	110	13	10.4881	4.70953	TBI	low	MeOH	1_6_11	110	200	368	12.1
341	1987	47	11	4	R	24	76	10	8.7178	4.34381	TBI	low	MeOH	1_6_11	110	200	368	12.1
342	1987	48	11	4	S	24	83	20	9.1104	4.43082	TBI	low	MeOH	1_6_11	110	200	368	12.1
343	1987	49	11	4	U	26	19	2	4.3589	2.99573	TBI	low	MeOH	1_6_11	110	200	368	12.1
344	1987	50	11	7	S	26	160	56	12.6491	5.08140	PFI	low	MeOH	1_6_11	110	200	368	12.1
345	1987	51	11	7	U	26	92	42	9.5917	4.53260	PFI	low	MeOH	1_6_11	110	200	368	12.1
346	1987	52	11	7	R	27	15	4	3.8730	2.77259	PFI	low	MeOH	1_6_11	110	200	368	12.1
347	1987	53	11	13	S	28	142	28	11.9164	4.96284	PFI	low	MeOH	1_6_11	110	200	368	12.1
348	1987	54	11	13	T	28	154	26	12.4097	5.04343	PFI	low	MeOH	1_6_11	110	200	368	12.1
349	1987	55	11	13	R	28	9	1	3.0000	2.30259	PFI	low	MeOH	1_6_11	110	200	368	12.1
350	1987	56	11	4	S	26	58	42	7.6158	4.07754	PFI	low	MeOH	1_6_11	110	200	368	12.1
351	1987	57	11	4	U	24	82	2	9.0554	4.41884	PFI	low	MeOH	1_6_11	110	200	368	12.1
352	1987	58	11	4	U	25	22	4	4.6904	3.13549	PFI	low	MeOH	1_6_11	110	200	368	12.1
353	1987	59	11	7	R	26	93	1	9.6437	4.54329	carb	low	MeOH	1_6_11	110	200	368	12.1
354	1987	60	11	7	U	26	173	15	13.1529	5.15906	carb	low	MeOH	1_6_11	110	200	368	12.1
355	1987	61	11	7	S	27	260	43	16.1245	5.56452	carb	low	MeOH	1_6_11	110	200	368	12.1
356	1987	63	11	13	R	27	102	4	10.0995	4.63473	carb	low	MeOH	1_6_11	110	200	368	12.1
357	1987	64	11	13	S	28	359	46	18.9473	5.88610	carb	low	MeOH	1_6_11	110	200	368	12.1
358	1987	65	11	4	U	24	77	2	8.7750	4.35671	carb	low	MeOH	1_6_11	110	200	368	12.1
359	1987	66	11	4	R	26	90	16	9.4868	4.51086	carb	low	MeOH	1_6_11	110	200	368	12.1
360	1987	67	11	4	S	25	182	35	13.4907	5.20949	carb	low	MeOH	1_6_11	110	200	368	12.1
361	1987	68	11	4	U	25	32	2	5.6569	3.49651	carb	low	MeOH	1_6_11	110	200	368	12.1
362	1987	41	12	8	S	33	165	72	12.8452	5.11199	TBI	low	MeOH	2_7_12	142	197	310	8.5
363	1987	41	12	18	S	19	176	46	13.2665	5.17615	TBI	low	MeOH	2_7_12	142	197	310	8.5
364	1987	42	12	8	U	36	60	2	7.7460	4.11087	TBI	low	MeOH	2_7_12	142	197	310	8.5
365	1987	42	12	18	T	18	150	3	12.2474	5.01728	TBI	low	MeOH	2_7_12	142	197	310	8.5
366	1987	43	12	8	R	37	61	50	7.8102	4.12713	TBI	low	MeOH	2_7_12	142	197	310	8.5
367	1987	43	12	18	R	18	80	4	8.9443	4.39445	TBI	low	MeOH	2_7_12	142	197	310	8.5
368	1987	44	12	20	S	10	278	36	16.6733	5.63121	TBI	low	MeOH	2_7_12	142	197	310	8.5
369	1987	45	12	14	T	21	165	8	12.8452	5.11199	TBI	low	MeOH	2_7_12	142	197	310	8.5
370	1987	46	12	14	R	21	104	8	10.1980	4.65396	TBI	low	MeOH	2_7_12	142	197	310	8.5
371	1987	47	12	5	S	24	197	27	14.0357	5.28827	TBI	low	MeOH	2_7_12	142	197	310	8.5
372	1987	48	12	5	U	22	36	10	6.0000	3.61092	TBI	low	MeOH	2_7_12	142	197	310	8.5
373	1987	49	12	5	U	22	115	8	10.7238	4.75359	TBI	low	MeOH	2_7_12	142	197	310	8.5
374	1987	50	12	8	U	33	73	10	8.5440	4.30407	PFI	low	MeOH	2_7_12	142	197	310	8.5
375	1987	50	12	18	T	19	129	3	11.3578	4.86753	PFI	low	MeOH	2_7_12	142	197	310	8.5
376	1987	51	12	8	R	36	10	26	3.1623	2.39790	PFI	low	MeOH	2_7_12	142	197	310	8.5
377	1987	51	12	18	R	18	29	8	5.3952	3.40120	PFI	low	MeOH	2_7_12	142	197	310	8.5
378	1987	52	12	8	S	37	116	68	10.7703	4.76217	PFI	low	MeOH	2_7_12	142	197	310	8.5
379	1987	52	12	18	S	18	142	27	11.9164	4.96284	PFI	low	MeOH	2_7_12	142	197	310	8.5
380	1987	53	12	14	T	17	40	2	6.3246	3.71357	PFI	low	MeOH	2_7_12	142	197	310	8.5
381	1987	54	12	14	R	19	91	4	9.5394	4.52179	PFI	low	MeOH	2_7_12	142	197	310	8.5
382	1987	55	12	20	S	11	225	37	15.0000	5.42053	PFI	low	MeOH	2_7_12	142	197	310	8.5
383	1987	56	12	5	U	24	32	10	5.6569	3.49651	PFI	low	MeOH	2_7_12	142	197	310	8.5
384	1987	57	12	5	R	24	38	8	6.1644	3.66356	PFI	low	MeOH	2_7_12	142	197	310	8.5
385	1987	58	12	5	S	21	88	0	9.3908	4.48864	PFI	low	MeOH	2_7_12	142	197	310	8.5

SAS

OBS	PROG_YR	VEH	FUEL	RUN	RATER	RUNTEMP	CTWD	HTWD	SQRTTWD	LOGITWD	SYS	TEMP	FUELTYPE	VOL	T10	T50	T90	RVP
386	1987	59	12	8	R	33	129	6	11.3578	4.86753	carb	low	MeOH	2.7_12	142	197	310	8.5
387	1987	59	12	18	R	19	118	16	10.8628	4.77912	carb	low	MeOH	2.7_12	142	197	310	8.5
388	1987	60	12	8	S	36	170	86	18.3303	5.82008	carb	low	MeOH	2.7_12	142	197	310	8.5
389	1987	60	12	18	S	18	336	56	13.0384	5.14166	carb	low	MeOH	2.7_12	142	197	310	8.5
390	1987	61	12	8	U	37	122	0	11.0454	4.81218	carb	low	MeOH	2.7_12	142	197	310	8.5
391	1987	61	12	18	T	18	274	19	16.5529	5.61677	carb	low	MeOH	2.7_12	142	197	310	8.5
392	1987	63	12	14	S	21	288	62	16.9706	5.66643	carb	low	MeOH	2.7_12	142	197	310	8.5
393	1987	64	12	14	T	19	244	2	15.6205	5.50126	carb	low	MeOH	2.7_12	142	197	310	8.5
394	1987	65	12	5	R	22	153	4	12.3693	5.03695	carb	low	MeOH	2.7_12	142	197	310	8.5
395	1987	66	12	5	R	22	73	30	8.5440	4.30407	carb	low	MeOH	2.7_12	142	197	310	8.5
396	1987	67	12	5	U	22	80	14	8.9443	4.39445	carb	low	MeOH	2.7_12	142	197	310	8.5
397	1987	68	12	5	U	22	18	18	4.2426	2.94444	carb	low	MeOH	2.7_12	142	197	310	8.5
398	1987	41	13	9	U	13	66	3	8.1240	4.20469	TBI	low	MeOH	3.8_13	143	230	370	9.2
399	1987	42	13	9	R	15	203	4	14.2478	5.31812	TBI	low	MeOH	3.8_13	143	230	370	9.2
400	1987	43	13	9	S	14	328	66	18.1108	5.79506	TBI	low	MeOH	3.8_13	143	230	370	9.2
401	1987	44	13	15	T	25	143	15	11.9583	4.96981	TBI	low	MeOH	3.8_13	143	230	370	9.2
402	1987	45	13	15	R	23	216	4	14.6969	5.37990	TBI	low	MeOH	3.8_13	143	230	370	9.2
403	1987	46	13	15	S	22	215	37	14.6629	5.37528	TBI	low	MeOH	3.8_13	143	230	370	9.2
404	1987	47	13	1	S	35	159	2	12.6095	5.07517	TBI	low	MeOH	3.8_13	143	230	370	9.2
405	1987	48	13	1	S	36	155	62	12.4499	5.04986	TBI	low	MeOH	3.8_13	143	230	370	9.2
406	1987	49	13	1	U	34	127	4	11.2694	4.85203	TBI	low	MeOH	3.8_13	143	230	370	9.2
407	1987	50	13	9	S	13	107	4	10.3441	4.68213	PFI	low	MeOH	3.8_13	143	230	370	9.2
408	1987	51	13	9	S	15	281	72	16.7631	5.64181	PFI	low	MeOH	3.8_13	143	230	370	9.2
409	1987	52	13	9	U	14	134	4	11.5758	4.90527	PFI	low	MeOH	3.8_13	143	230	370	9.2
410	1987	53	13	15	S	25	73	4	8.5440	4.30407	PFI	low	MeOH	3.8_13	143	230	370	9.2
411	1987	54	13	15	S	23	334	32	18.2757	5.81413	PFI	low	MeOH	3.8_13	143	230	370	9.2
412	1987	55	13	15	T	23	52	0	7.2111	3.97029	PFI	low	MeOH	3.8_13	143	230	370	9.2
413	1987	56	13	1	S	35	54	26	7.3485	4.00733	PFI	low	MeOH	3.8_13	143	230	370	9.2
414	1987	57	13	1	U	33	26	4	5.0990	3.29584	PFI	low	MeOH	3.8_13	143	230	370	9.2
415	1987	58	13	1	U	33	78	4	8.318	4.36945	PFI	low	MeOH	3.8_13	143	230	370	9.2
416	1987	59	13	9	S	13	523	147	22.8692	6.26149	carb	low	MeOH	3.8_13	143	230	370	9.2
417	1987	60	13	9	U	15	106	2	10.2956	4.67283	carb	low	MeOH	3.8_13	143	230	370	9.2
418	1987	61	13	9	U	14	402	2	20.0499	5.99894	carb	low	MeOH	3.8_13	143	230	370	9.2
419	1987	63	13	15	T	23	251	8	15.8430	5.52943	carb	low	MeOH	3.8_13	143	230	370	9.2
420	1987	64	13	15	R	23	323	8	17.9722	5.78074	carb	low	MeOH	3.8_13	143	230	370	9.2
421	1987	65	13	1	U	35	51	2	7.1414	3.95124	carb	low	MeOH	3.8_13	143	230	370	9.2
422	1987	66	13	1	R	37	15	4	3.8730	2.77259	carb	low	MeOH	3.8_13	143	230	370	9.2
423	1987	67	13	1	S	36	200	56	14.1421	5.30330	carb	low	MeOH	3.8_13	143	230	370	9.2
424	1987	68	13	1	U	34	18	0	4.2426	2.94444	carb	low	MeOH	3.8_13	143	230	370	9.2
425	1987	41	14	10	R	22	44	4	6.6332	3.80666	TBI	low	MeOH	4.9_14	115	227	319	12.0
426	1987	42	14	10	S	20	259	36	16.0935	5.56068	TBI	low	MeOH	4.9_14	115	227	319	12.0
427	1987	43	14	10	U	20	84	26	9.1652	4.44265	TBI	low	MeOH	4.9_14	115	227	319	12.0
428	1987	44	14	11	S	26	150	56	12.2474	5.01728	TBI	low	MeOH	4.9_14	115	227	319	12.0
429	1987	45	14	11	T	29	208	6	14.4222	5.34233	TBI	low	MeOH	4.9_14	115	227	319	12.0
430	1987	46	14	11	R	29	73	2	8.5440	4.30407	TBI	low	MeOH	4.9_14	115	227	319	12.0
431	1987	47	14	2	S	1	92	0	9.5917	4.53260	TBI	low	MeOH	4.9_14	115	227	319	12.0
432	1987	48	14	2	U	0	26	2	5.0990	3.29584	TBI	low	MeOH	4.9_14	115	227	319	12.0
433	1987	49	14	2	U	0	165	2	12.8452	5.11199	TBI	low	MeOH	4.9_14	115	227	319	12.0
434	1987	50	14	10	S	22	248	29	15.7480	5.51745	PFI	low	MeOH	4.9_14	115	227	319	12.0
435	1987	51	14	10	U	22	84	40	9.1652	4.44265	PFI	low	MeOH	4.9_14	115	227	319	12.0
436	1987	52	14	10	U	20	15	4	3.8730	2.77259	PFI	low	MeOH	4.9_14	115	227	319	12.0
437	1987	53	14	11	T	26	154	2	12.4097	5.04343	PFI	low	MeOH	4.9_14	115	227	319	12.0
438	1987	54	14	11	R	26	89	1	9.4340	4.49981	PFI	low	MeOH	4.9_14	115	227	319	12.0
439	1987	55	14	11	S	29	68	73	8.2462	4.23411	PFI	low	MeOH	4.9_14	115	227	319	12.0
440	1987	56	14	2	U	2	13	2	3.6056	2.63906	PFI	low	MeOH	4.9_14	115	227	319	12.0

OBS	PRGM_YR	VEH	FUEL	RUN	RATER	RUNTEMP	CTWD	HTWD	SORTTWD	LOG1TWD	SYS	TEMP	FUELTYPE	VOL	T10	T50	T90	RVP
441	1987	57	14	2	R	2	70	4	8.3666	4.26268	PFI	low	MeOH	4.9_14	115	227	319	12.0
442	1987	58	14	2	S	0	85	24	9.2195	4.45435	PFI	low	MeOH	4.9_14	115	227	319	12.0
443	1987	59	14	10	U	22	184	14	13.5647	5.22036	carb	low	MeOH	4.9_14	115	227	319	12.0
444	1987	60	14	10	R	22	156	28	12.4900	5.05625	carb	low	MeOH	4.9_14	115	227	319	12.0
445	1987	61	14	10	S	20	207	28	20.1742	6.01127	carb	low	MeOH	4.9_14	115	227	319	12.0
446	1987	63	14	11	S	29	216	80	14.6969	5.37990	carb	low	MeOH	4.9_14	115	227	319	12.0
447	1987	64	14	11	T	29	175	1	13.2288	5.17048	carb	low	MeOH	4.9_14	115	227	319	12.0
448	1987	65	14	2	R	1	177	0	13.3041	5.18178	carb	low	MeOH	4.9_14	115	227	319	12.0
449	1987	66	14	2	S	2	94	0	9.6954	4.55308	carb	low	MeOH	4.9_14	115	227	319	12.0
450	1987	67	14	2	U	0	62	2	7.8740	4.14313	carb	low	MeOH	4.9_14	115	227	319	12.0
451	1987	68	14	2	T	0	86	2	9.2736	4.46591	carb	low	MeOH	4.9_14	115	227	319	12.0
452	1987	41	15	17	T	31	51	17	7.1414	3.95124	TBI	low	MeOH	5_10_15	126	214	342	10.4
453	1987	42	15	17	R	30	52	4	7.2111	3.97029	TBI	low	MeOH	5_10_15	126	214	342	10.4
454	1987	43	15	17	S	29	215	68	14.6629	5.37528	TBI	low	MeOH	5_10_15	126	214	342	10.4
455	1987	44	15	12	T	29	82	6	9.0554	4.41884	TBI	low	MeOH	5_10_15	126	214	342	10.4
456	1987	44	15	19	R	18	25	4	5.0000	3.25810	TBI	low	MeOH	5_10_15	126	214	342	10.4
457	1987	45	15	12	R	30	116	4	10.7703	4.76217	TBI	low	MeOH	5_10_15	126	214	342	10.4
458	1987	45	15	19	S	19	208	30	14.4222	5.34233	TBI	low	MeOH	5_10_15	126	214	342	10.4
459	1987	46	15	12	S	31	208	14	14.4222	5.34233	TBI	low	MeOH	5_10_15	126	214	342	10.4
460	1987	46	15	19	T	19	164	18	12.8062	5.10595	TBI	low	MeOH	5_10_15	126	214	342	10.4
461	1987	47	15	3	U	6	41	2	6.4031	3.73767	TBI	low	MeOH	5_10_15	126	214	342	10.4
462	1987	48	15	3	R	13	65	4	8.0623	4.18965	TBI	low	MeOH	5_10_15	126	214	342	10.4
463	1987	49	15	13	S	13	101	2	10.0499	4.62497	TBI	low	MeOH	5_10_15	126	214	342	10.4
464	1987	50	15	17	R	31	47	4	6.8557	3.87120	PFI	low	MeOH	5_10_15	126	214	342	10.4
465	1987	51	15	17	S	30	159	48	12.6095	5.07517	PFI	low	MeOH	5_10_15	126	214	342	10.4
466	1987	52	15	17	T	29	118	6	10.8628	4.77912	PFI	low	MeOH	5_10_15	126	214	342	10.4
467	1987	53	15	12	R	29	29	4	5.3852	3.40120	PFI	low	MeOH	5_10_15	126	214	342	10.4
468	1987	53	15	19	S	18	157	23	12.5300	5.06260	PFI	low	MeOH	5_10_15	126	214	342	10.4
469	1987	54	15	12	S	29	211	22	14.5258	5.35659	PFI	low	MeOH	5_10_15	126	214	342	10.4
470	1987	54	15	19	T	18	205	10	14.3178	5.32788	PFI	low	MeOH	5_10_15	126	214	342	10.4
471	1987	55	15	12	T	29	60	0	7.7460	4.11087	PFI	low	MeOH	5_10_15	126	214	342	10.4
472	1987	55	15	19	R	13	41	2	6.4031	3.73767	PFI	low	MeOH	5_10_15	126	214	342	10.4
473	1987	56	15	3	R	6	52	4	7.2111	3.97029	PFI	low	MeOH	5_10_15	126	214	342	10.4
474	1987	57	15	3	S	2	105	20	10.2470	4.66344	PFI	low	MeOH	5_10_15	126	214	342	10.4
475	1987	58	15	3	U	13	17	2	4.1231	2.89037	PFI	low	MeOH	5_10_15	126	214	342	10.4
476	1987	59	15	17	S	31	238	56	15.4272	5.47646	carb	low	MeOH	5_10_15	126	214	342	10.4
477	1987	60	15	17	T	30	165	33	12.8452	5.11199	carb	low	MeOH	5_10_15	126	214	342	10.4
478	1987	61	15	17	R	29	131	14	11.4455	4.88280	carb	low	MeOH	5_10_15	126	214	342	10.4
479	1987	63	15	12	T	30	170	7	13.0384	5.14166	carb	low	MeOH	5_10_15	126	214	342	10.4
480	1987	63	15	19	R	19	114	4	10.6771	4.74493	carb	low	MeOH	5_10_15	126	214	342	10.4
481	1987	64	15	12	R	29	154	17	12.4097	5.04343	carb	low	MeOH	5_10_15	126	214	342	10.4
482	1987	64	15	19	S	2	340	36	18.4391	5.83188	carb	low	MeOH	5_10_15	126	214	342	10.4
483	1987	65	15	3	S	13	134	14	11.5758	4.90527	carb	low	MeOH	5_10_15	126	214	342	10.4
484	1987	66	15	3	U	13	101	2	10.0499	4.62497	carb	low	MeOH	5_10_15	126	214	342	10.4
485	1987	67	15	3	R	13	98	40	9.8995	4.59512	carb	low	MeOH	5_10_15	126	214	342	10.4
486	1987	68	15	3	S	13	75	0	8.6603	4.33073	carb	low	MeOH	5_10_15	126	214	342	10.4

SAS

```
10 REM This program calculates the TWD's of hydrocarbon fuels, gasohol
20 REM and ME0H/TBA fuels from T10, T50, and T90 data.
30 REM It will calculate TWD's at the two temperature levels tested
40 REM by CRC during the 1986/1987 Driveability Programs.
50 REM CAUTION --- This model is only valid for the cars tested during this
60 REM program, at the temperatures tested. In addition it is valid only for
70 REM fuels within the distillation range tested.
80 REM The T10 must be between 100 and 130
90 REM The T50 must be between 200 and 230
100 REM The T90 must be between 315 and 365
110 DIM G(10),I(10),K(10),S(10),L(10),H(10)
120 PRINT "WHAT IS THE T10, T50, AND T90 OF THE FUEL ? T10,T50,T90"
130 INPUT T10, T50, T90
140 REM Coefficients for the Distillation Temperatures - Intermediate Phase
150 B1= 4.304272E-02 :REM Coefficient for T10
160 B2= 4.546058E-02 :REM Coefficient for T50
170 B3= 1.366806E-02 :REM Coefficient for T90
180 FUEL= B1*T10 + B2*T50 + B3*T90
190 REM Intercepts from the 1986 Intermediate Temperature Program
200 I(1)= -12.83182 :REM Carb-HC
210 S(1)= .31762752# :REM Standard error from SAS program - STD ERR LSMEANS
220 I(2)= -11.79453 :REM Carb-EtOH
230 S(2)= .31719063#
240 I(3)= -10.63397 :REM Carb-MeOH/TBA
250 S(3)= .31449114#
260 I(4)= -14.93668 :REM TBI-HC
270 S(4)= .33660325#
280 I(5)= -13.60082 :REM TBI-EtOH
290 S(5)= .33728491#
300 I(6)= -12.90207 :REM TBI-MeOH/TBA
310 S(6)= .33344676#
320 I(7)= -16.20688 :REM PFI-HC
330 S(7)= .31708428#
340 I(8)= -15.31313 :REM PFI-EtOH
350 S(8)= .31638684#
360 I(9)= -14.61929 :REM PFI-MeOH/TBA
370 S(9)= .31439441#
380 PRINT
390 PRINT
400 PRINT " PREDICTED AVERAGE TWD'S DURING COLD START OF THE FOLLOWING FUEL"
410 PRINT " T10 = ";T10;" T50 = ";T50;" T90 = ";T90
420 PRINT " at Intermediate Temperatures of 48.5 Degrees F."
430 N=1
440 GOSUB 730
450 REM Intercepts from the 1987 Low Temperature Program
460 I(1)= -7.667526 :REM Carb-HC
470 S(1)= .3012348 :REM Standard Error
480 I(2)= -6.363455 :REM Carb-EtOH
490 S(2)= .3071936
500 I(3)= -6.286234 :REM Carb-MeOH/TBA
510 S(3)= .3182706
520 I(4)= -9.688441 :REM TBI-HC
530 S(4)= .2983948
540 I(5)= -9.599914 :REM TBI-EtOH
550 S(5)= .306163
```

```

560 I(6)= -8.093276      :REM  TBI-MeOH/TBA
570 S(6)=.3142977
580 I(7)= -10.67801      :REM  PFI-HC
590 S(7)=.3003226
600 I(8)= -9.947148      :REM  PFI-EtOH
610 S(8)=.3140574
620 I(9)= -9.627214      :REM  PFI-MeOH/TBA
630 S(9)=.3147863
640 REM Coefficients for the Distillation Temperatures - Low Temp. Phase
650 B1=3.778339E-02
660 B2=.0417624
670 B3=1.399633E-02
680 FUEL= B1*T10 + B2*T50 + B3*T90
690 PRINT
700 PRINT "  at Low Temperatures of  22.9 Degrees F."
710 GOSUB 730
720 END
730 REM Loop to estimate TWD's and High and Low precision limits.
740 FOR J=1 TO 9
750 G(J)= I(J)+FUEL
760 K(J)= G(J)|2
770 SD= 1.645      :REM No. of Std. Deviations used to Calc. Precision
780 REM Calculate the high and low precision limits of the estimates.
790 L(J)=(G(J) - SD*S(J))|2
800 H(J)=(G(J) + SD*S(J))|2
810 NEXT J
820 N=N+1
830 REM Change the following variables for different fleets of cars.
840 REM CAUTION --- The sum of the following fractions must total 1.0
850 REM The report title should also be changed from 72/11/17
860 CARB= .72      :REM Fraction of Carbureted cars in the fleet
870 TBI= .11      :REM Fraction of TBI cars in the fleet
880 PFI= .17      :REM Fraction of PFI cars in the fleet
890 REM Calculate the weighted average for the fleet.
900 FHC= (CARB*G(1) + TBI*G(4) + PFI*G(7))|2
910 FET= (CARB*G(2) + TBI*G(5) + PFI*G(8))|2
920 FOX= (CARB*G(3) + TBI*G(6) + PFI*G(9))|2
930 REM Calculate the precision limits of the fleet estimates.
940 PRECHC= SQR(CARB|2*S(1)|2 + TBI|2*S(4)|2 + PFI|2*S(7)|2)
950 PRECET= SQR(CARB|2*S(2)|2 + TBI|2*S(5)|2 + PFI|2*S(8)|2)
960 PRECOX= SQR(CARB|2*S(3)|2 + TBI|2*S(6)|2 + PFI|2*S(9)|2)
970 REM Calculate High and Low precision limits for the fleet
980 LFHC=(SQR(FHC) - SD*PRECHC)|2
990 LFET=(SQR(FET) - SD*PRECET)|2
1000 LFOX=(SQR(FOX) - SD*PRECOX)|2
1010 HFHC=(SQR(FHC) + SD*PRECHC)|2
1020 HFET=(SQR(FET) + SD*PRECET)|2
1030 HFOX=(SQR(FOX) + SD*PRECOX)|2
1040 PRINT
1050 PRINT "          CARBURETED          TBI          PFI          for 72/11/17"
1060 PRINT "                                FLEET"
1070 PRINT "          -----"
1080 PRINT " HC-FUELS      ";K(1);"      ";K(4);"      ";K(7);"      ";FHC
1090 PRINT " GASOHOL      ";K(2);"      ";K(5);"      ";K(8);"      ";FET
1100 PRINT " MECH-FUELS   ";K(3);"      ";K(6);"      ";K(9);"      ";FOX

```

```

1110 PRINT " "
1120 PRINT " The Estimated 90% Confidence Interval for the above Values is:"
1130 PRINT " "
1140 PRINT "          CARBURETED          TBI          PFI          for 72/11/17"
1150 PRINT "                                     FLEET"
1160 PRINT "          -----          -----          -----          -----"
1170 PRINT " HC-FUELS ";
1180 PRINT USING "####";L(1);
1190 PRINT " TO ";
1200 PRINT USING "####";H(1);
1210 PRINT " ";
1220 PRINT USING "####";L(4);
1230 PRINT " TO ";
1240 PRINT USING "####";H(4);
1250 PRINT " ";
1260 PRINT USING "####";L(7);
1270 PRINT " TO ";
1280 PRINT USING "####";H(7);
1290 PRINT " ";
1300 PRINT USING "####";LFHC;
1310 PRINT " TO ";
1320 PRINT USING "####";HFHC;
1330 PRINT " GASOHOL ";
1340 PRINT USING "####";L(2);
1350 PRINT " TO ";
1360 PRINT USING "####";H(2);
1370 PRINT " ";
1380 PRINT USING "####";L(5);
1390 PRINT " TO ";
1400 PRINT USING "####";H(5);
1410 PRINT " ";
1420 PRINT USING "####";L(8);
1430 PRINT " TO ";
1440 PRINT USING "####";H(8);
1450 PRINT " ";
1460 PRINT USING "####";LFET;
1470 PRINT " TO ";
1480 PRINT USING "####";HFET;
1490 PRINT " MEOH-FUELS ";
1500 PRINT USING "####";L(3);
1510 PRINT " TO ";
1520 PRINT USING "####";H(3);
1530 PRINT " ";
1540 PRINT USING "####";L(6);
1550 PRINT " TO ";
1560 PRINT USING "####";H(6);
1570 PRINT " ";
1580 PRINT USING "####";L(9);
1590 PRINT " TO ";
1600 PRINT USING "####";H(9);
1610 PRINT " ";
1620 PRINT USING "####";LFOX;
1630 PRINT " TO ";
1640 PRINT USING "####";HFOX;
1650 PRINT

```

FILE: TWDALC BASIC

I-75

```
1660 IF N=3 GOTO 720
1670 PRINT "Hit any key then ENTER "
1680 LINE INPUT N$
1690 RETURN
```